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ABSTRACT

The proceedings of the University Affiliated Program's Second Special Interdisciplinary Seminar, concerning Piagetian theory, are presented. The opening session dealt with the question "Can Piaget's Theory Provide a Better Psychometry?", C. E. Meyers, speaker. Among the papers reprinted in the proceedings from the afternoon program of Piagetian symposia, papers, test demonstrations and films are: (1) "Cognitive Development in Nursery School as Measured by a Battery of Piagetian Tasks" M. Lennan Nye; (2) "Keywords and Piagetian Concepts: A Suggestion" Jeannette Veatch; (3) "Piagetian Theory Related to Science and Math Curriculum Development" Richard Kimball (abstract); (4) "The Development of Subjective Responsibility: Differential Aspects" Betty Henry; (5) "A Child's Cognitive Conquest of Space and Time" Henry W. Maier; (6) "Cognitive Controls in Children and Performance on Piagetian Conservative Tasks" J. Roland Fleck (abstract); (7) "The Development of Young Cerebral Palsied Children According to Piaget's Sensorimotor Theory" F. Annette Tessier; (8) "Application of Piagetian Theory to the Development of the Concept of Space in Visually Limited Children" Rose-Marie Swallow and Marie K. Poulsen; (9) Application of Piagetian Theory to Exceptional Children" M. Patricia Simmons; (10) "Review of Recent Research Relating to . . . Volume Conservation During Adolescence" Marcia Maguire. (KM)

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# PROCEEDINGS

# SECOND ANNUAL UAP CONFERENCE

# PIAGETIAN THEORY AND THE HELPING PROFESSIONS

PS 006338

Piagetian Conference Planning and Editorial Committee: James F. Magary, Ph.D.
Marie Poulsen, Ph.D.
Gerald I. Lubin, M.D.
Gail Coplin, M.S.

Supported by MCH Grant #914

**Second Special Invitational Interdisciplinary Seminar**

Friday, January 21, 1972
Southern California Edison Auditorium, Hoffman Hall
Sponsored by University Affiliated Program*
Childrens Hospital of Los Angeles

Conference Program
A. M. Film Session
Edison Auditorium

Professionals who work with children are increasingly turning to Jean Piaget's work for guidelines in the study of the intellectual development of children. His theories describe the processes that characterize children's thinking at successive stages of development.

The following three films demonstrate PIAGET'S DEVELOPMENTAL THEORY. Viewers will find that these films clarify elements of Piaget's theory hitherto difficult to grasp and will find the films useful in understanding the thought processes of their students.

In the films, the tasks are given and analyzed by Dr. Robert Karplus, Professor of Physics, University of California, Berkeley, and Director of Science Curriculum Improvement Study; Dr. Celia Stendler Lavatelli, Professor of Education and Child Development, University of Illinois, Urbana; and Dr. Rita Peterson, Research Educator, Science Curriculum Improvement Study.

8:30 CONSERVATION – 28 minutes

Children between the ages of five and twelve are presented in individual interviews with tasks using the standard procedures developed by Piaget. The tasks involve conservation of quantity, length, area, and volume. The characteristics of thought from preoperational to formal are identified.

9:00 JEAN PIAGET MEMORY AND INTELLIGENCE – 45 minutes

A filmed documentary of Jean Piaget presenting his new work on memory and intelligence at the International Congress of Preschool Educational Specialists in Kyoto, Japan. Carefully translated English subtitles accompany Piaget's presentation in French.

9:45 CLASSIFICATION – 17 minutes

Children are shown at several developmental stages responding to tasks which highlight a different mental operation essential to classification such as multiple classification, class inclusion and hierarchical classification.

The films are available from: DAVIDSON FILMS
3701 Buchanan Street
San Francisco, Calif. 94123
Telephone: 567-2974

10:15 OPENING SESSION

Chairman: Gerald I. Lubin, M.D., Assistant Professor of Psychiatry and Pediatrics, University of Southern California, Assistant Program Director, University Affiliated Program, Childrens Hospital of Los Angeles.

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*University Affiliated Program is supported by grant (MCH Project #914) from Maternal and Child Health Services, Department of Health, Education and Welfare.

Speaker: C. Edward Meyers, Ph.D., Professor of Educational Psychology, University of Southern California.

TOPIC: CAN PIAGET'S THEORY PROVIDE A BETTER PSYCHOMETRY?

Reaction Panel:
Peter M. Bentler, Ph.D., Professor of Psychology, University of California at Los Angeles.

Gerald I. Lubin, M.D., Assistant Professor of Psychiatry and Pediatrics, University of Southern California, Assistant Program Director, University Affiliated Program, Childrens Hospital of Los Angeles.

James F. Magary, Ph.D., Director of Training in Education, University Affiliated Program, Childrens Hospital of Los Angeles, Associate Professor of Educational Psychology and Special Education, University of Southern California.

David Rigler, Ph.D., Professor of Psychiatry, University of Southern California Medical School, Chairman, Psychology Program, Childrens Hospital of Los Angeles.

Helmut Wursten, Ph.D., A.B.P.P., Associate Clinical Professor of Psychiatry (Child Psychology), School of Medicine, University of Southern California, Consultant, Childrens Hospital of Los Angeles.

Afternoon Program 1:30 - 3:00
Piagetian Symposia, Papers, Test Demonstrations, Films

A. **PIAGET AND THE PRESCHOOL CHILD**
Chairman: Mary Lou de Leon, R.M., M.N., Director of Training in Nursing, University Affiliated Program, Childrens Hospital of Los Angeles.

"Planning Effective Preschool Programs: An Application of the Assimilation - Accomodation Concept" – Greta Morine, Ed.D., Associate Professor of Education, California State College at Hayward.

"Cognitive Development in Nursery School as Measured by a Battery of Piagetian Tests" – M. Lennanne Nye, School Psychologist, Los Angeles County Schools, Doctoral Candidate, Educational Psychology, University of Southern California.

B. **IMPLICATIONS OF PIAGET FOR THE ELEMENTARY SCHOOL CURRICULUM**
Chairman: Gail Coplin, Doctoral Student, Educational Psychology, University of Southern California, Education Trainee, University Affiliated Program, Childrens Hospital of Los Angeles.

"Key Words and Piagetian Concepts" – Jeannette Veatch, Ph.D., Professor of Education, Arizona State University.

"Piaget's Task and Their Analysis" – Mildred K. Huff, Doctoral Student, College of Education, Arizona State University.

"Piagetian Theory Relating to Science and Math Curriculum Development" – Richard Kimball, Ph.D., Assistant Professor, Department of Teacher Education, California State College at Hayward.

"Implications for Structured Learning From a Study of a Miniature Linguistic System " – Wylla D. Barsness, Ph.D., Associate Professor of Psychology, Boise State College, Idaho.

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C. **BASIC RESEARCH STUDIES IN PIAGETIAN THEORY**

Chairman: Judith Grayson, Doctoral Student, Educational Psychology and Special Education, University of Southern California.

"Egocentric Thought Related to Peer Rating Nominations" – Sara K. Stampp, Graduate Student, Educational Psychology, University of California, Berkeley. (Master's Paper.)

"The Development of Subjective Responsibility: Differential Aspects" – Betty Henry, Graduate Student, Educational Psychology, University of California, Berkeley. (Master's Paper.)

"Acquisition of Some Relational Terms and Concepts: Mother-Child Interaction and Social-Class Differences" – Margaret R. Wilcox, Lecturer and Research Educator, University of California, Berkeley.

"Child's Cognitive Conquest of Space and Time" – Dr. Henry W. Maier, Professor of Social Work, University of Washington. Paper will be read by Priscilla Wong, M.A., O.T.R., Adjunct Assistant Professor, Department of Occupational Therapy, University of Southern California, Rancho Los Amigos Hospital.

"Cognitive Controls in Children and Performance on Piagetian Conservative Tasks" – J. Roland Fleck, Ed.D., Assistant Professor of Psychology, Rosemead Graduate School of Psychology.

D. **PIAGET AND ASSESSMENT**

Chairman: Christine Harris, Ph.D., Director of Training in Communicative Disorders, University Affiliated Program, Childrens Hospital of Los Angeles.

PAPER: John C. Gowan, Ph.D., Professor, San Fernando Valley State College, The Implications of Piagetian Theory of Sounselling and Guidance.

"Test Demonstration" – Harold O. Stern, Ph.D., Fellow, Psychology, University Affiliated Program, Childrens Hospital of Los Angeles. Demonstration and discussion of Use of Concept Assessment Kit – Conservation (Marcel L. Goldschmid and Peter M. Bentler).

E. **SYMPOSIUM: APPLICATIONS OF PIAGETIAN THEORY TO THE HANDICAPPED CHILD**

Chairman: Marie Poulsen, Ph.D., Doctoral Fellow, University Affiliated Program, Childrens Hospital of Los Angeles, Assistant Professor, California State College at Los Angeles.

**Participants:**

Annette Tessier, Ed.D., Assistant Professor, Department of Special Education, California State College at Los Angeles. "Development of Young Cerebral Palsied Children Based on Piaget's Sensorimotor Theory."

Rose Marie Swallow, Ed.D., Assistant Professor, Department of Special Education, California State College at Los Angeles. "Piaget Space Concepts in Low-Vision Children."

Patricia Simmons, Ph.D., Assistant Professor, Department of Special Education, California State College. "Effects of Language Deficit on Children's Representation of Space."

F. **PIAGETIAN CONCEPTS OF CONSERVATION AND VELOCITY**

Chairman: Kiomars Fiazi, Psychology Instructor, Los Angeles City College.

"Review of Recent Research Relating to the Emergence and the Age of Attainment of Volume Conservation During Adolescence" – Marcia Maguire, Graduate Student, Educational Psychology, University of Southern California.

"Cross Cultural Investigation of Conservation" – Peter M. Bentler, Professor of Psychology, University of California at Los Angeles.

"The Perception of Relative Velocity in Elementary School Children" – Kiomars Fiazi, Psychology Instructor, Los Angeles City College.

A Study of 1st and 2nd Graders on Conservation Tasks as Related to Academic Subjects – Jule Dombrower, Graduate Student, Department of Behavioral Science at California State College, Dominquez Hills; and George Marsh, Professor of Psychology, California State College, Dominquez Hills.

G. **THE FOLLOWING FILMS WILL BE SHOWN IN THE EDISON AUDITORIUM BETWEEN 1:00 and 3:30.**

FORMAL THOUGHT – 32 minutes – illustrates tasks that challenge the thinking of secondary school students. The tasks involve proportional reasoning, separation of variables, combinatorial logic and the integration of these in an analysis – a balanced beam with weights. (Davidson Films.)

GUIDING ENVIRONMENTAL DISCOVERY (Super 8mm) 2 films – focuses on a six month old baby in the first film, and the same 18 month old baby in the second film; the film explores ways of providing experiences which foster the child's intellectual growth. The material is based on Piagetian research. Films were made by Dr. Ruth Formanek, Professor of Elementary Education, Long Island University, Hemstead, New York and are available from her.

OBJECT PERMANENCE – 35 minutes – a new film description of a scale by Dr. Harvey H. Corman and Dr. Sybelle K. Escalona. Records the administration of this individual scale of cognitive functioning. The other two films are also from this series.

SPATIAL RELATIONSHIPS – 40 minutes – continuation of Corman-Escalona Scales.

CAUSALITY – 21 minutes – continuation of Corman-Escalona Scales.

The above three films are available from The New York University Film Distribution Department.

H. **INVITATIONAL SEMINAR FOR PIAGETIAN SCHOLARS AND RESEARCHERS**

Hoffman Hall 301
By invitation only. 3:30 - 4:30 p.m.

# Can Piaget's Theory Provide a Better Psychometry?

C. E. Meyers
University of Southern California

This presentation has a double purpose. One is to make a gentle introduction to the developmental psychology of Jean Piaget. The other is to discuss a potential utilization of the remarkable demonstrations of Piaget in the remaking of scales of mental measurement, together with the problems which will beset such a utilization.

We begin with Piaget himself, not only because he is so colorful, but because his own history helps to explain his psychological theory. Picture a physically tall and gracious man, with a healthy pink skin and flowing white hair, one and the same pipe in his mouth just about all of the time he is not speaking, everybody's grandfather, now somewhat past 70. That is the man who, after years of incomplete recognition, has it made now, being adulated wherever he goes, in demand for personal appearances everywhere in the world. He has produced a prodigious amount of empirical investigation, and has developed a so-called cognitive-developmental theory that takes hold all over, so that now he is the most quoted psychologist in the United States, perhaps in the world.

Who is this man of the hour? How do we explain him? *First* of all, we explain him in part to say that he started in biology. He was such a precocious student and had published such good scientific work that his name became regionally famous. As a mere adolescent he was considered for an institute directorship. He proceeded to a Ph.D. in biology, following which he directed his entire post doctoral life to a study of what must have been to him a perfectly normal extension of his biology. The biology of his time featured the dynamic, progressive adjustment of a species member in its environment; that is, the individual in an ecological relation with an environment, an environment which has to be reacted with differently depending upon the stage of development of the species. Piaget might just as well have studied the ontogenesis of the honey bee or the yucca moth. Instead, he selected the growth of human mental ability, broadly conceived to include language, dreams, fantasy, logic, concepts of justice and morality. He has called himself a student of developmental epistemology – that is, a student of how the child comes to know and to adapt with his mental competence.

He has, therefore, a biologist's bias for the study of the generalized case. He was *not* mainly interested in individual differences; he was *not* interested in impaired development, in the dull or the bright, nor in sex differences nor in differences of any kind whatsoever. He probably has yet to calculate his first standard deviation. Although he studied very few children, he studied enough children to satisfy himself that once he saw the sequence of developmental stages, he could believe he had found the true course of development. Why be redundant, especially when the interest is in the *general* instance, not in the variety of possible minor variations. Parenthetically, it is pointed out that his colleagues, his laboratory, do study, with his methods, the reatrded, the gifted, the insane. Himself, he did not.

This bias then, helps explain why many have considered his findings inadequate, his number of cases insufficient, his description of subjects beneath what we would permit of the masters candidate. He was not interested in age norms as such and provided none, merely stating that a given phenomenon occurs generally about 5 or 6 months or 7 or 8 years of age. Many criticisms have been addressed to this; but again, norms were not his bag, but *sequence* was; stage into evolving stage was.

To achieve his ends then, he produced an astounding amount of empirical research in a variety of topics in children's mental life. But he did not stop with being an empiricist. He theorized along with his work, mostly *ad hoc* theory (little evidence of a hypothetico-deductive approach that I have noted), summarizing his research in terms of theory as he built it.

A *second* background feature, which explanatory value is the site of his observations. He came from French-speaking Switzerland, spending his adult life in Geneva, Switzerland, the home of that great beatnik of 200 years ago, that hippie, Jean Jacques Rousseau, who preached that message of minimal formal acculturation with which you are familiar; a sort of John the Baptist in reverse, crying repent, not for your sins *of* nature, but for your sins *against* nature, because you tried to do too much civilizing of the child. He was the great preacher of innate goodness which society corrupts.

This setting of Rousseau might be related to the basic posture Piaget takes about child development vis a vis formal education. His theory is not a naive maturationism, like Gesell's, to which it is most often likened, but a theory of development by interaction, producing a growth which will take place normally if you provide an environment in which it can occur. It is a learning approach, but not an SR learning approach; rather it is a child-directed, internally organized development. When Piaget is asked whether such and such a training might speed up the attainment of a stage, he has two answers. The first is philosophical. He says, Oh, that is the American question. Why do you want to speed up the natural pace? He will point out also that any time you teach something, you deprive the child of the opportunity to discover it. Then he gives his scientific-empirical answer, which is that you can't speed any mental development even if you wanted, because the growth of mental structures takes its own time, one thing having to consolidate itself before the next can develop from it.

Figure 1 gives a skeleton of the cognitive theory. In the beginning, the first two years, is the sensory-motor period. At

the very start the helpless infant can only receive the environment, he cannot act back upon it except through a few defensive reflexes and through his ability to cry. Progressively he develops his sensory motor competencies – early defensive reactions, hand movements to touch and grasp, to feel, to bite. By the sixth month he discriminates the significant and regular persons, and will soon show distress if others care for him. His object relations – sizes, distances, textures, temperatures – become greatly enriched when he can locomote, when he will go behind, up and over, down under, to explore the world of objects and persons and movements.

The sensory motor period is not a waste of time in cognitive development, nor is it merely a period of maturation of tissues. Rather, it is the time to develop the object relations, the ability to predict continuity of motion, to use cues, and to have telegraphic language, all of which permit passage into the so-called transductive pre-operational level. Objects and people are now pretty stable. Notice object constancy as a development which permits you to infer "mental" activity. The 10-month baby does not have much of it. You take away a sharp, dangerous object by substituting the bottle or the favorite rattle, and the baby drops the dangerous object, so that it is now out of sight, and hence out of mind. He does not turn back to it. He cannot find it where you hid it behind a small screen. But now, say at 18 months, he remembers very well, he looks back for, he predicts, he relates what is absent with what is present. He has basic percepts, he has object constancy. The sensory-motor period has permitted this preoperational stage, roughly age 2 - 7, to come about.

Now objects have names, names evoke the objects to mind, and objects evoke the names. There are no true concepts, according to Piaget, till about 4, as the child does not generalize the objects into classes. From 4 on the child goes into intuitive conceptualization, he will begin to perceive likenesses across different instances. But at 4 he is not quite ready to think with and through concepts. Ask him to sort out miscellaneous objects, putting some here which go together, others there which go together, and he will display only fleeting, trivial bases upon which to separate the objects – and these bases will change while he is in process. Ask him why these were put here, and he'll say they're red. Why are these others here, he'll say he likes them. After age 5 or so he will get more systematic. Why so? Because he can more surely abstract out some essence such as color or size, and see it in common in different objects. In doing so he shows true concepts.

The stage of concrete thinking operations comes in at about 6 or 7 years of age, well established by 8, typically. Let's use the classification task as an example.

We put out 6 carnations and two or three miscellaneous other flowers. We get the child to acknowledge this is a flower, this is a flower, this is a flower, this is a carnation, this is a carnation, etc. But we ask him, are there more carnations than flowers, or more flowers than carnations, and he will answer, more carnations, before about 6 years of age. Same with 5 cows, one horse, one pig. Are there more cows than animals or more animals than cows?

Why doesn't he cope? Because he cannot yet do the thinking operation which can maintain a hold on one conceptual system while handling a second one – he cannot at the same time grasp the belongingness of cows among animals generically or carnations among flowers generically.

The mastery of such classification and the development of the conservations indicate that the child has now reached the stage of concrete thinking operations. The more mature child, say of 7 or 8, can see the relation of one conceptual system against another. He is not confused by the dual membership of this flower as both a carnation and a flower. Concrete thinking operations means the child can manage his thoughts, to come out with an explanation of such relations or of other penomena, and can reverse his direction and go the other way too, as in 3 + 4 = 7, but 7 take away 3 gives 4.

Concrete thinking operativity is demonstrated in conservation, and conservation demonstrations are the most famous of all Piagetian tasks in our country, and they are both easy to do and convincing, especially if you will compare, say, one or more four-year-olds with some eight-year-olds. The examiner transforms a substance, and the child who conserves appreciates that there has been no alteration in the amount of the physical substance, merely a change in form. The capacity to grasp the continued reality of the physical substance through change of its appearance is conservation. The nonconserver appears ready to believe that a sausage made out of clay is actually more clay now. Let us go through the typical steps of conservation of fluid, because they will show the clinical method as used, the examiner's checks on the child's apparent understanding, and the relative insignificance of language.

(1) We initially check language or check it during the demonstration to determine that there is no problem with quantity words such as more, less, the same, etc.

(2) We check equivalence of levels. We pour water into two equal beakers. The child tells us that they are different or same, and may instruct us to increase one to make them equal, to his satisfaction.

(3) Now we pour one into a taller, higher beaker. We ask, which one has more water. If he conserves, he must explain. We go on.

(4) We reestablish initial equivalence to the child's satisfaction. We now pour one into a wide, shallow dish. We ask again which has more.

(5) We pour water from one into several small ones of the same shape. Can he conserve now? Can he explain if he does?

(6) At one point or another, if he conserves, we say to him, another boy or girl said this one has more water, and we

point to the higher or the shallower one. This is called "counter suggestion," and is a test to determine whether the child merely heard how he was to respond.

(7) If he passes up to here, we try what is called the "control procedure. We have him pour the same amount of water into two or three beakers of different sizes. We determine whether he adjusts by making the water high in a tall one, shallow in a wide one, etc.

You see how patient and painstaking this demonstration was, requiring several minutes for one subject. You see that passing is not dependent on merely by knowing a few key words such as "more" or "same." The child himself must be able to mentally adjust for the change of physical shape by explaining that you took none away, you added none, you have the same water but now it's shallower but wider, etc.

A variety of demonstrations of conservation are employed – with clay; 6 blocks compressed together vs spread out; long trains through a tunnel vs short ones; one-for-one correspondence of pennies for pop bottles. They have different degrees of difficulty, and the most difficult require formal thinking operations.

These latter, formal thinking operations, may be briefly described as the ability to be logical with pure abstractions as well as with the concrete. The x in algebra, representing any or all quantities; the if-then logic in hypothetic-deduxtive science; the logic of axioms and derivations from them; the nature of assumptions and propositions. The stage is reached at 11 years or so, and in high school and college is represented in the abilities to work in algebra, pure grammar, symbolic logic, and the like.

The title of this address implies that psychometry ought to be improved, and that maybe a study of Piaget can improve it. What is wrong with present psychometry that we should want to do so? A look around you indicates that very much is not well. We have a variety of attacks upon such instrumentation as the Binet and the WISC that they are culturally baised, that they do not measure what they purport to, namely pure mental development, that they misidentify nonfamiliarity with difficulty. Let us take a somewhat technical look at the kinds of items in the Binet and WISC and how they got into and stayed in such scales.

Items were selected originally by Binet and his people to represent typical competence of children at the several age levels. What could be performed by about 60 per cent of five-year-old children constituted mental age five. What six-year-olds could do constituted MA 6, and so forth. The items were mixed, some teasing memory, some requiring analogy, some drawing of diagrams, definitions of words, recognizing and naming common objects. Thus was the Binet initiated, and thus we have had the criterion for mental age placement of Binet-type items ever since. Note that the criterion of placement is empirical or statistical difficulty.

Now there are other bases for the selective retention of items, particularly internal consistency. Today I want to delimit my complaint about existing scales, which have not changed motably in the 60 years since Binet, to the one issue of the simple empirical difficulty of items and the mischief implicit in that practice. A lot of the items in the WISC and Binet meet a statistical difficulty criterion, but not a logical criterion, such as inclusion, or complexity, or abstractness. WISC and Binet vocabulary scales represent the problem. Taking as an example for discussion, we can show the most difficult items of the Stanford-Binet vocabulary. Why are these words placed at this Superior Adult III level? Because very few persons in the norm groups could define the words. Why not? Some of them are not difficult. The highest word of all is not at all abstract, not inclusive, or complex in any way. It is a common noun, a name for certain easily discriminated objects, though most of you may not be familiar with it. The next word is somewhat subtle in its nature and does indeed require abstractness to comprehend and to define. The third most difficult merely means sweaty, and again, probably some of you did know that, but it is not at all difficult to teach a child to say, "Gee Mom, I'm all sudorific" when he comes in after touch football in the front yard. The fourth is also simple and you should not need much mental age to pass it. The fifth is truly abstract, while the sixth is not. Thus, of the six most statistically difficult words, only two of them might be said to represent levels of subtle abstractness which would truly mark the very superior adult.

We can make similar fun of items in Wechsler's tests as well, but let us generalize the point: many specific items in the Binet and WISC have not been placed in an order of difficulty arrived at because they inherently carry complexity or inclusiveness or emergent abstractness, but only because they were empirically determined to be failed or passed by particular proportions of people. To take a ridiculous example, probably nobody in this room full of graduate students and other scholars knows the word for "cow" in Afghanistan. That makes knowing the Afghan word for "cow" a mark of an extremely brilliant intellect, we can state cynically. Difficulty of this sort may only be obscurity, and may change overnight with Sesame Street or a shift of geographical interest. This in part is the reason you can say intelligence tests are not culturally fair, and is one reason the testing movement is under the gun.

The key point of a potential Piagetian psychometry is that the tasks would be ordered primarily by a logic other than or in addition to a statistical pass-fail ratio. The task would require functioning by the child, not just knowing, and the functions would be ordered, in the ideal instance, such that B could not be performed till A was under control. This is the same as saying, with regard to postural and locomotor development, that before the child will stand he will sit, and before he will walk he will stand. It is the same as being able to add before being able to multiply.

Since Piagetian demonstrations are now rather universally known and very well replicated, it is probably true that hundreds of informal and formal attempts to scale mental development in Piaget's tasks are in process. I am aware on this campus of two doctoral dissertations, one by Berman which scaled Piaget to compare with the WISC and Binet in the study of retardation, another, by Dr. Sharp which attempted to determine whether some conservation items would be culture fair in identifying EMR children. We have had several masters papers to my knowledge. One recent one is by Mr. Yoshida, in special education, who developed a Guttman scalogram with several dozen trainable retarded children, in part replicating Piaget and Inhelder. Without doubt, the same interest would be evinced on any campus, either to make a scale as such, or to use Piagetian tasks as predictor variables, control factors, or dependent variables. Piaget is *in*.

What about serious scale making? I direct attention to four efforts, and will mention more, in which competent scaling, following something of the logic I have mentioned, has been attempted. There is to my knowledge only one formally standardized, normed, validated, and published scale, that of Goldschmid and Bentler. Dr. Goldschmid is at McGill in Montreal while Dr. Bentler is usually found at UCLA when he is not here in this auditorium platform. This, which they call the Concept Assessment Kit – Conservation, is a fully standardized scale resulting from a selective retention of conservation items, complete with scoring protocols, norms, item statistics, validity data, formal announcement, designed for 4 - 8 years of age. There are parallel forms, A and B, and a slightly different scale C.

Of importance to us is that not only here is a first published scale, but that today's sophisticated level of standards in test scaling and publishing have been applied to Piagetian content, thus making some progress toward answering questions like these:

(1) Is conservation all one achievement in development?

(2) If it is all one, do some particular concrete achievements antecede others?

(3) Is any such sequence immutable, or does it vary with culture and other factors?

The first question, is conservation all one achievement, has an answer in the Goldschmid-Bentler area. Yes, in general. the tasks in scales A and B appear to be homogeneous – conservation is, by these tasks, substantially one functi... Scale C is slightly different, not orthogonal to A and B, but enough different to merit some separate attention.

The next question, do some achievements in conservation antecede others? Yes, as found by many others, these scholars replicate the observation that substance conservation, for example, is far easier than volume. Is that sequence immutable, or does it vary? In general, the replication within conservation is in an order of difficulty generally found, but, as others have shown, some children get out of order with achievements in some tasks, even when the children are homogeneous in subculture. As to cross cultural stability of the tasks and age norms, Goldschmid and Bentler have not gone into that, but have a scale which, more than previous efforts, permits cross cultural investigation to go on systematically. Meantime, there is a plethora of other cross-cultural evidence indicating group differences in ages of achievements, but generally supporting Piaget in the order or achievements. Recall that the Goldschmid and Bentler scales are on conservation only. They are not yet the replacement for the Binet or the WISC as broad scale samplings of mental functioning. We will return to this issue later.

A second effort worth mentioning is the rather collossal production of the two other Montreal scholars, at the University of Montreal, Laurendeau and Pinard. They appear to be undertaking a complete survey of Piagetian phenomena for children from about 2 years of age and up into early adolescence. Whether this effort is to make scales for the market, or merely to do tidy-up work on Piaget, I do not know. They have, however, produced by now two books, *Causal thinking in the child* (1962) and *The development of the concept of space in the child* (1970). Each research was painstakingly faithful to the clinical method of Piaget, but was more systematic in the description of subjects, tests, and results. They conducted the work to answer criticisms of Piaget's own insufficiency of numbers or incomplete pursuit of his own ideas, or to answer criticisms of those who have claimed, with quick and easy (rather than slow) methods, that Piaget had poor data and poorer conclusions.

Each study involved hundreds of cases, spread over a succession of age levels. The results seem to have definitively resolved many doubts about certain Piagetian speculations and to have filled gaps in knowledge, while discovering more. In general the results support Piaget and correct him. What is of interest to us this morning is that the data do produce tasks which do have good but not perfect ordinal character. The waiting public asks, will they put scales on the market?

It is suggested you do not anticipate scales from them very soon. For one matter, the Montreal scholars appear to be interested more in research than in supplying the clinical market. For another, consider the practicalities. Their first book, exploring causal thinking, with questions about five areas of phenomena to be explained, such as What is nighttime, What about dreams, together with some other testing, required 10 hours of examining time, over 4 yo 8 sessions per child. It is obvious that a practical test would have to consume much less time, and hence run the risk of departing from the main purpose.

In their second book on spatial conception I did not find any mention of time consumption, but since a great deal of handling of object and map type material was involved, I would guess the series took hours. To summarize, Laurendeau and Pinard did not give us a scale in the Goldschmid and Bentler sense, but they appear to have all the makings

for one, up *to* final selection and norming of items.

This same practical difficulty of testing time was admitted by our third scaling person. This is Prof Read Tuddenham of Berkeley, about whom it has been said for years that he was embarked on test construction a la Binet. However, one cannot find a scale, or any detailed account, only articles about the problems of construction with some illustrative data. He tells of attempting to apply scaling rigor to the tasks while making them into efficient, essentially nonverbal test items, perhaps sacrificing something, perhaps not. He finds disappointing, low interitem correlations, suggesting that either the items lack reliability or that separate functions are being sampled – that is to say, possibly separate factors in Guilford's sense – or both. Reviewing Prof Tuddenham's writing, one does indeed come to a belief that he also found, as did Laurendeau and Pinard, the apparently nonglobal nature of Piagetian tasks, which then apparently can contain two or more separate scales. I have mentioned by now the published scales of Goldschmid and Bentler, the Laurendeau and Pinard books, and Tuddenham's eventual publication of a scale. One repeatedly hears stories of how the Geneva group, particularly somebody named Vinh Bang, are making a more or less universal scale. I have noted such mentions for several years now, but without evidence of a scale. Perhaps somebody in the discussion group or somebody in the audience knows more than I and will share his information.

And now some attention to infant level scales. It is here that the developmental work is easier, for the infant is more primitive, and stages are much easier to identify and to put in order than in later, more fully cognitive life. There are many efforts – one film today will show Corman and Escalona's work. Still another is that of Formanek. Let me take up still another which is creating some excitement. This is an infant-level developmental appraisal by Uzgiris and Hunt, in preliminary form, but one which they are pleasantly ready to share with scholars. The object relations and other phenomena described for the sensori-motor period by Piaget are ordered into a Gesell-type scale – again with the conviction that, before this, comes that. Uzgiris and Hunt and others are using the scale for observations of infants, to determine, for example, how different mother-ings affect development. Parskevopoulos and Hunt, in a paper due for imminent publication, have used scale items as a dependent variable in comparing three groups of infants in Greece. One was in a foundling situation with a ratio of caretakers to infants of 10 to 1, another with a ratio of 3 to 1. A third group was in their own homes, presumably 1 to 1. The results showed the mean ages of such a particular attainment in object relations respectively to be 33.3 months, 21.8 months, and 20.3 months. Presuming that there was no serious confounding variable to which the results would be in part attributed, we have a clear victory for motherhood. What may escape you is this, the results if dependable are clear Piaget and learning theory, and clearly non-Gesell, in that they show how adaptation comes through interaction with the environment, not just growth-in-time.

We return to the title of this paper, can Piagetian theory provide a better psychometry. We can ask the question in several ways.

In one, we ask, will we ever go from Piaget into a single comprehensive scale of mental development in which all items are perfectly aligned, perfectly Guttmanized? The answer is probably no. In the first place, as Goldschmid and Bentler, Laurendeau and Pinard, Piaget himself, and others have determined, you cannot count on *no* instances of slippage or decalage as they call it in French – differences in pass-fail do appear at least in different tasks on the same attainment. Furthermore, genuine differences, amounting to fundamental factors so to speak, arise in the attempt to find parallelism in major aspects of development. Piaget himself, as verified by Laurendeau and Pinard, showed different courses for spatial conception and representation on the one hand and the more or less purely verbal causal logic. Goldschmid and Bentler have information from good sampling that conservation of physical substance itself may be divided.

Thus, come 1984, we will probably have *scales,* not just one scale. Each will be established in homogeneity of the function sampled, there will be at least two of them, perhaps more. Each of these can consist of items not only ordered statistically, but items of mental process essentially in a logical sequence. They may not satisfy criteria for a pure Guttman scale but they should have good reproduceability.

A second question concerns assumptions about the alleged permanence vs. inconstancy of the trait you measure with a scale. Since Watson's day, American psychologists may be seen as divided into camps about attitude toward testing. Trait measurement by some people such as Terman of the Stanford-Binet was equivalent to establishing the child's more or less permanent level, permitting early and confident prediction and placement into special tracks or programs, such as EMR or gifted, with excess and obscene confidence in the stability of the measurement. Others, influenced by the SR behaviorist tradition, saw such use of testing with revulsion, having a belief of a different sort, that traits were highly responsive to training, and IQ's as traps for our thinking.

Well, Piagetian scaling would first of all not very naturally yield a quotient and would not presuppose a fixed quantitative statement of individual differences. It would measure degrees of stage attainment of maturity, and might forecast, as Inhelder did, the ultimate or maximum stage of mental competence one would expect in a child. Piagetian scale scores would not necessarily be responsive to training, as we saw, but a scale would be more palpable than Binet or WISC in scaling of human process ability or abilities. They

would hold up in face validity before civil rights disputants and before human development investigators looking for descriptive and control variables. The scales would have an immediate relation to educational programming than presently can be secured from the essentially anomalous scores of current measurement, which are interpreted only in norms. Another way to say this is that you will get a description of the child's state of coping ability having instant meaning for him, and not dependent for interpretation on a comparison with other children. We'd have in effect criterion referenced measurement in mental development.

Keep in mind that Piaget's theory is an interactionist theory, basically a somewhat naturalistic learning-upon-maturation conception, and is not an SR theory and does not carry the SR theorist's complete optimism for what can be achieved with intensive direction, so I do not mean to imply that cognitive-developmental scaling will satisfy all SRists.

Third, will such scaling give us the second coming, the mystical culture fair or culture free test? No, this hope cannot be held out. Piagetian theory holds that development is due to interaction, and some cultures differ in the provisions for good interaction, including physical and mental health as well as good books and language in the home. But the several cross cultural studies show that while rate of going through major processes will differ by culture (for example, slower in lower status families in America than in middle status families), the order, the sequence, is not violated.

In short, therefore, I perceive that 1984 can bring us measurement based on process rather than information, with scores more surely valid as so-called human ability, ability that is probably in the plural. However, such scale development will be a long time coming without substantial financial underwriting.

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# Cognitive Development In Nursery School Children As Measured by a Battery of Piagetian Tasks[1]

M. Lenann Nye

## Introduction

By way of an introduction I would like to share with you how I became interested in studying Piaget and conducting a research study utilizing Piagetian tasks. The study which I will discuss today was conducted during 1967-1968 as my master's thesis. My initial interest began, however, during my senior year of undergraduate school when I was taking a course in Exceptional Children under Dr. Mary Meeker. During her course I volunteered to do some field work with a battery of Piagetian experiments. The next year I entered graduate school in the field of Educational Psychology. After only a few weeks I found myself at a loss at what to write my thesis on. I called Dr. Meeker with a desperate cry of Help. What to write about? Accordingly, she suggested that I might like to extend and revise the work she had begun on the Piagetian tasks as she would not be able to continue her work on it at the present time. The idea was exciting and I began work immediately.

## Rationale Behind the Study

The basic Piagetian concepts and methodologies were well discussed this morning so I shall be brief in my introduction of the rationale behind my study. As Dr. Meyer's mentioned this morning, Piaget never has claimed that his experiments were in any way standardized nor did he observe a very large number of children upon which to base his conclusions. However, since Piaget's system of concrete operations represents an attempt to impose a formal model of the reasoning processes of children, it is only natural that a logical extension of his work would be an endeavor to standardize his tasks and in so doing possibly compare such variables as sex, age, socio-economic level and ethnic group as these variables may effect a child's performance. I don't think I need mention the importance and significance of these variables and how they influence a child's cognitive development.

There are at least three primary reasons why a battery of Piagetian tasks would prove to be a useful tool for professionals:

1. The Piagetian tasks can be used in the assessment of the individual child's general level of intellectual development, of his specific scholastic aptitudes, and as a test for readiness levels for various kinds of instruction, such as number readiness. In this manner Piagetian results can be used towards practical educational matters such as grade placement and assignments to remedial training programs when necessary.
2. The planning of curricula can be done in the context of Piagetian developmental findings. I believe Dr. Morine will be discussing more specifically implementation of the Piagetian concepts in the classroom.
3. Piaget's theory also has a good deal to say about the nature of cognitive thought processes and the ways in which unknown externals become internals. Thus, using his methodology it is possible that we could learn something about the more favorable conditions for learning and hence improve our teaching techniques.

## PROCEDURES

### Sample and Methodology

A battery of ten Piagetian tasks were administered to 470 nursery school boys and girls in order to compare the effects of socio-economic level, sex, chronological age, and ethnic group differences as these factors effect their development of intelligence according to Piaget's sequential, invariant stage theory. Administration of the test battery was done by senior and graduate students at the University of Southern California.

The sample consisted of 470 children, 228 boys and 242 girls. The age range was from 3.0 years to 5.0 years. The socio-economic levels were divided into three levels: lower (n=85), lower middle (n=189), and upper middle (n=196). Three divisions were used to describe the sample in terms of ethnic grouping: Caucasians (n=314), Mexican-Americans (n=51), and Negroes (n=105). No attempt was made to make this sampling population representative of any particular population as a whole but is merely an agglomeration of cases. The sample was also divided into groups according to age. This age distribution was divided into five equal intervals of four months: Age 36-40 mo. (n=57), Age 41-45 mo. (n=66), Age 46-50 mo. (n=101), Age 51-55 mo. (n=132), and Age 56-60 mo. (n=114).

### Test Battery:

Before discussing the results of this study I would like to present and demonstrate some of the ten Piagetian tasks which made up the test battery. If you will refer to the handouts we will go through each task. Table I presents a summary of the task codes and the descriptions of the Piagetian tasks used.

[1] Beckenbach, Madelene Lenann. "Cognitive Development in Nursery School Children as Measured by a Battery of Piagetian Tasks." Unpublished Master's Thesis, University of Southern California, 1969.

TABLE 1
Codes and Descriptions of Piagetian Tasks

| Task Content | Subtask Code | Description of Task |
|---|---|---|
| Space Representation | S.R.-1 | Ability to conceptualize objects as they are located on an Euclidean Grid of horizontal coordinates. |
| Conservation of Number | C.N.-1-1 | Ability to count verbally from one to ten. |
| | C.N.-1-2 | Ability to count ten stones in a row. |
| | C.N.-1-3 | Ability to recognize the conservation principle when ten stones are placed in a pile as compared to a row. |
| | C.N.-2-1 | Ability to count verbally from one to ten. |
| | C.N.-2-2 | Ability to count ten poker chips in a row. |
| | C.N.-2-3 | Ability to recognize the conservation principle if ten chips are placed in a pile as compared to a row. |
| | C.N.-2-4 | Ability to recognize the conservation principle between two rows of poker chips of equal number. |
| | C.N.-3-1 | Ability to make a one-to-one correspondence with poker chips by making a row of equal chips as in a demonstration model. |
| | C.N.-3-2 | Ability to recognize the conservation principle with chips in two unequally spaced rows. |
| Conservation of Discontinuous Quantities | C.D.Q.-1-1 | Ability to recognize conservation principle of two equal sets of beads placed into two equal sized boxes. |
| | C.D.Q.-1-2 | Ability to recognize conservation principle when equal sets of beads are placed into unequal sized boxes. |
| Conservation of Length | C.L.-1 | Ability to distinguish differences in length between a straight piece of wood and an undulating thread. |
| Conservation of Area | C.A.-1 | Ability to recognize conservation of area as identical cubes are placed on equal sized squares of paper but where the cubes are placed in different arrangements. |
| Classification | Cl.-1 | Ability to place a potpourri of objects in a logical hierarchial order, and thus distinguish subclasses from universal classes. |
| | Cl.-2 | Ability to distinguish a subclass from its universal class. |
| Conservation of Quantity | C.Q.-1 | Ability to recognize conservation of quantity when one piece of clay is transformed into a sausage while an original piece retains its shape of a ball. |

TABLE 2

Percentage of Subjects in Each Piagetian Stage

| Tasks | Stage I | Stage II | | Stage III |
|---|---|---|---|---|
| | | Stage IIa | Stage IIb | |
| Space Representation | | | | |
| S.R.-1 | 79.5 | -- | | 20.5 |
| Conservation of Numbers | | | | |
| C.N.-1-3 | 35.9 | 27.1 | | 37.0 |
| C.N.-2-3 | 34.9 | 25.9 | | 39.2 |
| C.N.-2-4 | 36.0 | 10.7 | | 53.3 |
| C.N.-3-1 | 8.9 | 26.8 | 49.2 | 15.1 |
| C.N.-3-2 | 45.1 | -- | | 54.9 |
| Conservation of Discontinuous Quantities | | | | |
| C.D.Q.-1-2 | 40.3 | 32.3 | | 27.4 |
| Conservation of Length | | | | |
| C.L.-1 | 40.5 | 23.4 | 36.1 | -- |
| Conservation of Area | | | | |
| C.A.-1 | 47.1 | 26.3 | 13.1 | 13.5 |
| Classification | | | | |
| Cl.-1 | 59.2 | 30.7 | | 10.0 |
| Cl.-2 | 10.0 | 42.9 | 15.2 | 32.0 |
| Conservation of Quantity | | | | |
| C.Q.-1 | 82.5 | -- | | 17.5 |

## RESULTS

The statistical method applied to the data was the chi square within a contingency table format. The null hypothesis was only rejected if the .05 confidence level was reached.

**Findings Relevant to Sex Differences**

Five of the seventeen tasks showed significant differences between sexes. Of these five tasks, two (C.N.-1-2 and C.N.-2-2) tested the child's ability to count from one to ten. The other three tasks included the ability to deal with the principle of conservation of numbers (C.N.-2-3, C.N.-2-4, and C.N.-3-1). Where significant differences existed it was found that the girls were more successful with the tasks than the boys.

**Findings Relevant to Age Differences**

Ten out of the seventeen tasks were found to have significant differences for different age intervals. These ten tasks included the following: space representation (S.R.-1), conservation of discontinuous quantity (C.D.Q.-1-1), conservation of area (C.A.-1), and seven of the tasks involved conservation of numbers (C.N.-1-1, C.N.-2-3, C.N.-2-4, C.N.-1-3).

**Findings Relevant to Ethnic Group Differences**

Of the seventeen tasks, eleven showed significant differences existing between the three ethnic groups. The significant tasks found for this variable were: space representation (S.R.-1), conservation of discontinuous quantities (C.D.Q.-1-1 and C.D.Q.-1-2), classification (C1-1 and C1-2), and the remaining tasks were concerned with conservation of numbers (C.N.-1-1, C.N.-1-3, C.N.-2-2, C.N.-2-3, C.N.-3-1, and C.N.-3-2). It was found that in general, in terms of the level of cognitive development of the Mexican-American children functioned uniformly at the lowest level of cognition with Negroes next and the Caucasian children consistently functioning at the highest level.

**Findings Relevant to Socio-Economic Levels**

There were only two tasks that were not found to differentiate between the three socio-economic levels. These two tasks were conservation of length (C.L.-1), and conservation of quantity (C.Q.-1). It was found, in general, that lower socio-economic groups functioned at the lowest level of cognitive development while the upper-middle group functioned almost consistently at the highest level of cognitive development for the sample.

**Findings Relevant to the Distribution of Cases between Stages**

As part of your handout material you have a summary table, Table 2, which gives the distribution of subjects, regardless of age in each Piagetian stage. As can be seen by this table there exists a wide fluctuation in difficulty level between the various Piagetian tasks. While a number of the tasks have approximately the same level of difficulty, no simple pattern exists. There does appear to be some general findings which are relevant to the findings reported on this table.

These findings include:

1. There does exist a wide fluctuation in the difficulty level of the type of tasks used in the battery, with percentages of subjects found at stage I ranging from 8.9% to 82.9%.
2. Criteria for classifying children in the three developmental stages is not consistently parallel thus each task must be considered independent of others.
3. The most difficult task for this sample was with "conservation of quantity."
4. The task with which the largest percentage of children were able to pass at Stage III was fourth of the tasks involving conservation of number, thus, there may be positive support here for training effect.
5. There is found general agreement with Piaget's theory that cognitive development takes place in a sequential, invariant order. Thus, with the exception of only slight degree of variance, as the subject's age increases there is a decrease of those found to be in Stage I and an increase of those found in Stage III.
6. The more critical the scoring criterion the better the distribution within stages assumes the normal distribution curve.

**Summary and Conclusion**

Interpretation of the findings of this study must be made according to the criterion described and the population from which the sample was selected. However, many of the findings seem to warrant a more general application. These conclusions include:

1. Cognitive development does take place in a sequential, invariant order.
2. Children who are able to apply the concept of conservation with one type of material cannot necessarily do so when dealing with another type of material. The explanation for this is possibly that the conservation concept is applied first to specific situations and materials and becomes generalized through experience.
3. Not all children at the same age are functioning at the same level of cognitive development. This has important implications for the readiness theory.
4. In general, children are more successful at relating conservation of number than with other forms of conservation.
5. Socio-economic level is the most significant variable affecting the child's level of cognitive development.

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# © Keywords and Piagetian Concepts: A Suggestion

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Ever since I read Sylvia Ashton-Warner's *Spinster* and *Teacher*, I have been trying to explain some of this observed phenomena while demonstrating her "Key Vocabulary" with children. The most puzzling thing, to me, aside from the fact that no major figure in the field of reading thought much of her idea, was the intense possessiveness of each child over his own words. Why, I wondered, did they have such a fascination? Why was it so difficult to get a child to throw away those words he could not remember, even though it was obvious that this action produced far more vital, powerful words in the long run?

Recently, I was struck with the similarity of behavior of children with their key words, and other children who clearly were in the concrete operational stage doing the classic Piagetian experiments. Might there be a relationship between Key Words and Conservation? May I present some of my thinking that this, as a hypothesis, might make some sense.

For example, a child demonstrating his understanding of conservation with water, when the liquid from one glass was poured into a taller glass says:[1]

It's still the same, because, I saw before in the other glass that it was the same –
*But how can it be the same?*
You empty it and put it back in the others!

This is an example that could be replicated a thousand times. The child that has reached the stage of conservation, has internalized its meaning. He cannot be fooled by changing the size and shape of the glasses.

Let me compare for you another child that has been working to give one of my undergraduate students (a completely inexperienced teacher) some key words. Note that the inexperience of the observer does not obscure how the child feels about words of such internal importance.

A week later I returned to the classroom, eliciting the "key" words. This was an *enlightening* experience for both of us. It was serious learning on her part, and excitement, for her key words were her reality, and Indian it was. As she had gone to visit her grandmother that weekend her words were images of this environment (she often goes to the reservation apparently) "mountains," "sky," "grass," "wind," "night." The words were so real to her, her world, and as a result of her excitement I suggested she compose a story about her words. I wrote and it was a beautiful composition . . . . *She wanted to take it home after our session* . . . . (emphasis added)

Let us take another example of a child who shows understanding of another Piagetian task, that of seriation and correspondence. The child was to arrange a series of sticks and dolls in pairs from large to small. Of course, the preoperational child could not complete the task, no matter how much coaching he received. Another more mature child talked as he maneuvered the objects.[2]

*Are the dolls alike?*

Oh, no, they get smaller and smaller, and that's the smallest.

*Do you know which stick belongs to which doll? How can we find out?*

We must arrange them smaller, smaller, smaller (he did so).

Clearly this child has achieved conservation, and can reverse the order of the sticks and dolls. The term reversibility is used to indicate such inner understanding. When the child achieves such a state of understanding, Piaget considers him to have achieved equilibration.

Let us turn again to children as described by Sylvia Ashton-Warner in her book, *Teacher*.[3] Note again this evidence of equilibration with *words:*

"Mohi," I ask a new five, an undisciplined Maori, "What word do you want?"

"Jet!"

I smile and write it *on a strong little card* and give it to him.

. . . . "What do you want, Seven?" Seven is a violent Maori.

"Bomb! Bomb! I want bomb!"

So Seven gets his word "bomb" and *challenges anyone to take it from him.*

"Tigers" is usually a word from the European children but here is a Maori with it. So I give him "tigers" and *never have I to repeat this word to him,* and *in the morning the little card shows the dirt and disrepair of passionate usage* . . .

Out press these words, grouping themselves in their own wild order. All boys wanting words of locomotion, aeroplane, tractor, jet, and the girls words of domesticity, house, Mummy, doll. Then the fear words, ghost, tiger, skellington, alligator, bulldog, wild piggy, police. The sex words, kiss, love, touch, haka. *The key words carrying their own illustrations in the mind, vivid, and powerful pictures which none of us could possibly draw for them – since in the first place we can't see them and in the second because they are so alive with an organic life that the external pictorial*

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[1] Molly Brearley and Elizabeth Hitchfield, *A Guide to Reading Piaget* (New York City: Schocken, 1966), p. 9.
© Jeannette Veatch
[2] Ibid, P. 18.
[3] Simon and Schuster (New York City, 1963), p. 35ff.

*representation of them is beyond the frontier of possibility . . . The tendency is for them to gather force once they are said . . .* (emphasis added.)

For a final contrast between these two operations, linguistic and mathematical, may I again quote a child who is drawing how water would look no matter how a bottle (with water in it) would be tilted. He says, " . . . because water cannot slant; it's always straight (i.e., horizontal) because water must always be straight."[1]

If you would grant that I have shown that key words, properly elicited, are analogous to conservation in Piagetian terms, then I could say that each key word is a word that is *conserved.* That is, it is internalized. It does not need to be taught. It is understood, perhaps not in its formal definition, but as one child said, "I know all about it." His word was "whale." He had never seen a whale. His knowledge was a product of sheer understanding of some source, and vicarious source it had to be, of what a whale was. When this boy was asked why he liked that word best on that day, he replied, "Because it is a big, BIG fish!" He was only six.

If key words are the only ones that can be said to be conserved, then they are the only ones that need not be drilled upon or imposed. As to the rest of the words that children use when talking they, of course, would be of lesser importance in impact, even though far more numerous. These would be service words, and other categories in which the child is not interested.

Piaget advocates have demonstrated, (May I recommend the writings of Millie Almy and Richard W. Copeland as remarkably lucid?) that mathematical operations are not internalized, not understood, not usable and certainly not teachable to the child until he has reached that state of Nirvana where, plunk! equilibration, security, knowledge comes about.

There are at least three research studies that indicate a parallel development using Sylvia Ashton-Warner's innovative idea. I refer to Athol B. Packer's work with Follow-Thru children, which showed that such words were not of the stuff of the basal readers.[2] Also Eleanor Barnette's work at the University of Arizona, showing the significantly improved ego concept of children on a Key Vocabulary program, as well as improved attitudes toward reading.[3] In addition, Raymond J. Duquette, at Arizona State University demonstrated that children under a Key Vocabulary program performed better, significant at the 0.01 level of confidence, in word meaning, paragraph meaning, and word study skills in reading as measured by the Stanford Achievement Test; and in writing in the number of (1) running words, (2) words spelled correctly, (3) different words, and (4) polysyllabic words.[4]

While obviously three studies do not make a hypothesis completely, incontrovertably proven, nevertheless, these are significant straws in the wind that tend to support my proposition that the phenomenal quality of children clutching their key words to their bosoms, has its origins in the comparable quality of conservation as explored by Piaget.

In closing I must say that if Piaget is right in that children move through sensori-motor pre-operational stages differing in ages but not in sequence, to that concrete operational stage of thorough going understanding, then a similar kind of development must take place as children proceed through the years to the operation of learning to read and write.

If Piaget is critical of attempts to impose mathematical learning in an effort to speed it up, then analogous attempts to impose learning to speed up reading should also be criticized as fruitless. Not only do the studies above so suggest, but other numerous studies of self-selection in reading,[5] and those of the 27 studies of beginning reading,[6] are not in opposition.

Inasmuch as the majority of teachers in America, and the world, for that matter, do not use children's own language, let alone their dialects, in developing the skills of literacy; inasmuch as the majority of programs of beginning reading instruction impose language other than the children's own, a comparison of a linguistic operation with the most powerful and vital of children's language, and a mathematical operation on the most demonstrable of developmental stages, shows how inadequate, now non-developmental are our procedures to develop the skills of literacy.

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[1] Brearley and Hitchfield, op. cit., p. 96.

[2] Athol B. Packer, "Sylvia Ashton-Warner's Key Vocabulary for the Disadvantaged," *Reading Teacher,* International Reading Association, Vol. 23, No. 6, pp. 559ff.

[3] Eleanor A. Barnette, "The Effects of A Specific Individualized Activity on the Attitudes Toward Reading of First and Second Grade" (unpublished E.D.D. dissertation, University of Arizona, 1970).

[4] Raymond J. Duquette, "An Experimental Study Comparing the Effects of A Specific Program of Sign Vocabulary Upon Reading and Writing Achievement of Selected First and Second Grade Children" (unpublished Ph.D. dissertation, Arizona State University, 1970).

[5] Sam Duker, *Individualized Reading* (Metuchen, New Jersey: Scarecrow Press, 1969).

[6] Russell G. Stauffer, editor, *The First Grade Reading Studies: Findings of Individual Investigations* (Newardk, Delaware: International Reading Association, 1967).

**Piagetian Theory Related to Science and Math Curriculum Development**

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ABSTRACT

Creative growth is the man-induced, systematic, creative form of change that produces improvements in existing structures or originates totally new ones. Creative growth is a methodology for producing outcomes that are productive, predictable and controllable.

This study asks the following question: If progress is to be maintained and problems solved by carrying out a program of creative growth, how is this program to be implemented? Any improvement in developmentally-relevant levels of progress within socio-cultural, economic-technical, political, psychological or constitutional institutions, is due not only to the resources at hand but in the opportunities for change that are available.

Resources include the human and the natural. Human resources are made of several dimensions including the psychological: affective and cognitive.

Schools are one of the most prominent institutions in any community for implementing development and progress. If a program that reinforces those features that produce creative growth could be implemented, improvements may be possible in the young that would greatly influence activities in their later life.

The Uganda Government has been developing new curricula, especially in science, which they hope will significantly contribute to creative growth. The influence of a new science curriculum on the intellectual and emotional growth of children forms the main content of the research of this study.

In what ways would a change in the curriculum in the primary schools lead to a change in development levels? Many authors (J. Piaget, P. G. Vernon, T. Husen, T. W. Schultz, D. Smith, A. Inkeles among others) have implied that rational thinking and planning, a creative approach to problem solving and an emotional control that allows for empathy, are necessary (but not necessarily sufficient) psychological conditions to maximizing the utilization of resources with flexible alternatives for creative growth.

The objectives of this study are as follows:

A. To describe variables and to propose hypotheses relating and to evaluate their relevance to the prediction of future trends.

B. To analyze the results of testing these hypotheses and to evaluate their relevance to the prediction of future trends.

C. To produce viable suggestions describing some methods through which primary schools can be improved to increase an individual's chance for raising his level in development-specific structures through creative growth, given the set of alternatives and resources at his command.

The variables being considered here as most influential in producing changes in development-relevant learning are as follows: educational experience (years of school, attendance-nonattendance), type of school (new science curriculum, old science curriculum), age, location of school (Buganda rural and urban, Bugisu rural and urban), outreach (trips to urban areas, exposure to media), socio-economic status (SES).

The following dependent variables are measured: cognitive development (rationality, creativity), affective development (self image, want fulfillment), school achievement and economic return.

Test questions which were used to measure the above variables were devised by the author in previous research in East Africa and Mexico and by other researchers in cross-cultural studies. These questions were modified in a pre-test of 144 students, pupils, adults and non-school children near Kampala, the capital of Uganda. Three research assistants, two from Buganda and one from Bugisu, were chosen from over 35 university applicants. They collected classroom, ethnographic and census information as well as the interview data used in testing the hypotheses.

The sample tested was all male. 1,228 children and adults were interviewed in the four ecological settings. Twenty school children each from grades one, four and six from new science curriculum and old science curriculum schools were selected. Twenty non-school boys with ages and socio-economic backgrounds similar to those of the pupils were the comparison group. Adults from these role categories completed the sample in each setting: farmers, laborers, craftsmen, shopkeepers, officials, teachers.

These relationships among independent variables are proposed:

Adults:

Outreach generally is dependent on a person's SES. The richer can afford radios, television and newspapers. They tend to live in the urban areas and have more eduxation. Outreach is also a direct function of location. An individual who lives in an urban area is more likely to be influenced by "modernizing" forces than one living in a rural area.

Generally, the younger the adult the higher his education level.

Non-school children:

age

Location, SES and outreach are related similarly for non-school children as with adults. Age is independent of location.

Pupils:

curriculum

educational experience (school – non-school)

age (years of education)

Note: Variables without arrows are fully independent. Variables at the beginning of a causal link can also be considered independent.

The following are the hypotheses and the results of their testing.

Related to children:

1. Pupils in all schools teaching the new science curriculum will score significantly higher on measures of affective and cognitive development and school achievement.

Hypothesis one is confirmed. Results are significant at the .001 level.

2. Pupils in urban schools will score signifixantly higher than pupils in rural schools on measures of affective and cognitive development and school achievement.

Hypothesis two is confirmed. Results are significant at the .001 level.

3. Pupils from higher SES homes will score significantly higher on measures of cognitive and affective development and school achievement.

When controlled for location, hypothesis three is not confirmed.

4. School children will score significantly higher than non-school children of the same age and background on measures of cognitive and affective development.

Hypothesis four is confirmed. The results are significant at the .001 level.

5. Children taking more trips to an urban area, using the radio, television and newspaper more will score significantly higher on measures of cognitive and affective development and school achievement than children not so oriented.

Hyptohesis five is confirmed. The significance level falls from .001 to .01 when location and SES are controlled for.

6. The older the child (the higher the grade level) the significantly higher will be his score on measures of cognitive and affective development and school achievement.

Hypothesis six is confirmed. The results are significant at the .001 level.

7. The six variables (curriculum location, SES, outreach, education and age) will explain a significant portion of the variance in scores measuring cognitive and affective development and school achievement in children.

Regression analysis yields these results.

Per Cent Variation Explained by Each Independent Variable
(school children)

| Dependent Variable | Independent Variable | | | | | | |
|---|---|---|---|---|---|---|---|
| | curriculum | location | SES | outreach | education | age | TOTAL |
| rationality | 7.9 | 2.3 | .1 | .1 | 20.00 | 8.1 | 38.5 |
| creativity | 1.3 | 7.0 | 1.1 | .7 | 21.50 | 8.7 | 39.3 |
| self image | 6.0 | 3.6 | .2 | .1 | 7.7 | 4.5 | 22.1 |
| want fulfillment | 2.0 | .7 | 1.3 | .3 | 16.4 | 1.5 | 22.2 |
| school achievement | .6 | .3 | .1 | .1 | 20.0 | 5.8 | 26.9 |

Per Cent Variation Explained by Each Independent Variable
(non-school children)

| Dependent Variable | location | SES | outreach | age | TOTAL |
|---|---|---|---|---|---|
| rationality | 11.1 | 1.1 | 1.4 | 37.4 | 51.0 |
| creativity | 8.7 | .2 | 1.3 | 27.8 | 38.1 |
| self image | 16.6 | 1.0 | 3.5 | 11.0 | 32.1 |
| want fulfillment | 7.1 | 2.6 | 4.0 | 2.7 | 16.4 |

Hypothesis seven is logically confirmed in that a significant proportion of the dependent variables (especially the cognitive variables) is explained by the independent variables.

Hypotheses related to adults:

1. Adults in urban areas will score significantly higher than adults in rural areas on measures of cognitive and affective development and economic return.

Hypothesis one is confirmed. Results are significant at the .001 level.

2. Adults coming from higher SES homes will score significantly higher on measures of cognitive and affective development and economic return.

Hypothesis two is confirmed. The significance value reduces from .001 to .01 when location is controlled for.

3. Adults living in or taking more trips to urban areas, using radio, television and newspapers more will score significantly higher on measures of cognitive and affective development and economic return than those not so oriented.

Hypothesis three is confirmed. The significance value reduces from .001 to .01 when location and SES are controlled for.

4. The more years of school completed by adults the significantly higher will be their scores on measures of cognitive and affective development and economic return.

Hypothesis four is confirmed at the .001 level of significance.

5. The older the adult the significantly higher the score on measures of cognitive and affective development and economic return.

Hypothesis five is not confirmed. The relationship is positive until age 35 and then becomes negative. Each effect cancels the other for the total sample.

6. The five variables (location, SES, outreach, education and age) will explain a significant portion of the variance in scores measuring cognitive and affective development and economic return in adults.

Per Cent Variance Explained by Each Independent Variable
(adults)

| Dependent Variable | Independent Variables | | | | | |
|---|---|---|---|---|---|---|
| | location | SES | outreach | education | age | TOTAL |
| rationality | 0.9 | 1.0 | .1 | 30.2 | 4.7 | 36.9 |
| creativity | 3.0 | 1.6 | .1 | 21.0 | 2.4 | 28.1 |
| self image | 6.9 | 0.1 | .1 | 10.0 | 0.1 | 17.2 |
| want fulfillment | 1.3 | 0.1 | .3 | 60.0 | 2.2 | 63.9 |
| economic return | 0.1 | 0.5 | 5.0 | 38.0 | 1.2 | 44.8 |

Hypothesis six is logically confirmed. A significant portion of each dependent variable has been explained.

The results show that the new science curriculum in its first year of operation does contribute significantly to psychological development. It is speculated that since education is strongly associated with development-related learning outcomes (adult results), a new science education may contribute even more to these outcomes as these children become adults.

Further findings include a reduced inclination of the educated to *want* to live in the cities and to have large families.

As education level increases there is the tendency to accumulate and manipulate those materials and human resources that are prerequisite to increasing development levels and subsequent progress.

Hopefully the new science curriculum will lead to changes in other curricula so that a more rational and creative approach can be used to solve the problems that are within man's control.

From observations in the classroom and an analysis of teaching strategies the new science curriculum classrooms exhibit a tendency toward more flexible approaches to

teaching. This flexible approach includes use of materials for each individual to interact with, evaluation of results of experiments, teacher as colleague instead of authority, affective growth as well as cognitive, process over content, freedom of exploration, creativity as well as logical processes, teaching for an unknown future.

Further studies should shed light on whether or not these observations form significant influences in the education process. Is it the style of teaching or the scientific process or both? Can this approach be used in other subject areas? Will the results then be multiplied?

This research brings out the need for researchers and curriculum developers to be in Piaget's "formal operations" stage of development so that future accomplishments may add even further significance to our understanding of change and growth.

# The Development of Subjective Responsibility: Differential Aspects

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There are two large areas of research and thought concerning the development of responsible behavior in children. One is the study of the acceptance of responsibility at any particular age for completing tasks or behaving in an increasingly mature manner. Those researching this aspect tend to develop lists of "responsible behaviors," characterize children according to some criterion, and then by how they measure up to the first scale. Another trend is to study responsibility in a developmental manner, as Piaget has done. Studying it in terms of moral dilemmas, he has traced changes in a child's concept of responsibility as he matures. In this way, he has specified two stages in the development of responsibility – "objective responsibility" in which acts are judged by their consequences or size alone, and a later "subjective responsibility" in which intentions achieve primary importance. These changes are reflected in both actual behavior and in a child's verbalisms. Studying three separate areas in which responsible behavior is observed (clumsiness, stealing and lying), Piaget makes no attempt to further differentiate responsibility except to say that parental training has been shown to have an effect in the age of acquisition of the second stage. The present study was an attempt to determine whether age differences in the development of subjective responsibility could be differentiated further, and, if so, whether the research concerning the acceptance of specific responsibilities could generalize to the development aspects studied by Piaget. An adaptation of Piaget's methods was used.

## Background

### Traditional Methods

Harris et al (1954), using several methods, including the Teacher's Check List of Responsibility (measuring such things as promptness in school) developed by Havighurst, and a citizenship scale (measuring conformity to social norms) based on the one developed by Gough, McCloskey and Meehl, studied 4,000 white school children in both rural and urban areas to further categorize the term "responsibility." On the different scales he found significant differences in the amounts of responsibility assumed by different groups, with older children assuming more than younger ones, girls more than boys, and urban children more than rural ones. He was, however, unable to find significant correlation between the various measures of responsibility, except with children over fifteen years old, because he could find no unitary trait of responsibility in children. He concluded that there was "little evidence of a marked developmental process of responsibility in children." It would seem more accurate to say that the study indicated the likelihood that there is no *uniform* developmental trait of responsibility.

A study of moral character by Hartshorne and May (reported in Kohlberg, 1968), although not referred to by Harris, would tend to corroborate this interpretation. These researchers were unable to find any general character traits corresponding to words such as honesty, and concluded that what one does in one situation is not necessarily going to generalize to another. It would seem likely that this could also be true of responsibility in various situations.

In another study, Harris (1954a) correlated the number of home chores performed by children with their scores on the same responsibility indices he used before, and found little evidence that routine home tasks are associated with an attitude of responsibility. From this he concluded that it is perhaps not imposed tasks, but rather self-induced experiences and tasks which affect the development of responsibility. This is similar to the conclusion of Coleman (1964), who, in her introduction to a symposium on the topic of responsibility in adolescents, stated the likelihood that children will learn what they need to perform in their present environment only, and that imposed tasks or experiences will not benefit the growth of responsibility.

A study by Walters et al (1958), using Walters' own checklist, studied the differing assumptions of various groups concerning the age at which children could accept various home and public responsibilities (such as hanging up clothes or returning borrowed property without reminders). Asking groups of white mothers, Negro mothers, specialists and college students, he found no significant differences in expected ages, but a uniform agreement that girls should be able to assume responsibility at an earlier age than boys.

Zunich (1963) carried this design one step further by asking the children themselves at what ages they thought the responsibilities measured by the Walters scale should be assumed. He used over 500 sixth grade students, both lower and middle class, as subjects, measuring responsibilities that are usually assumed between the ages of five and ten, and found, with statistical significance, that lower class children uniformly put responsibility at a later age than the middle class children did. He concluded that children's "perceptions concerning the development of responsibility are dependent upon social class." This finding brings up an interesting comparison with the Harris (1954)research, in which he determined that the urban child accepts responsibility before the rural one. No one has yet studied how the urban-poor or suburban-middle class would compare.

### Summary

So far, then, we have indications from Harris' work that older children exhibit more responsible behavior than younger ones, girls show more than boys and urban children

more than rural ones. Walters agrees with the finding that girls tend to be more responsible than boys at each age level. Zunich determined that the middle class child is more responsible than the lower. Several investigators seem to agree that responsibility is a quite varied term, and that perhaps it is not uniform across situations with any one child.

The above studies have some limitations. The first one would be their tendency to use checklists. Although specific items were checked for validity, frequently by several judges, to determine whether they measured responsible behavior, there appears to have been no differential validation done. Responsibility appears not to have been clearly and uniformly defined by the judges, and, as a result, different lists were, in effect, frequently measuring different traits – some confusing responsibility with honesty ("I wouldn't sneak into a movie if I could"), others with obedience ("Take a bath without their mother's help after they had been reminded to do so"), and still others with some highly subjective characteristics ("Parents should attend PTA regularly") or skills (operate a duplicator). In this sense the difficulty at correlating measures is largely a semantic problem – a failure to define terms before checking to see if there is a single trait, responsibility.

The studies so far listed were uniform in their lack of theoretical background presented. The researchers appear to have felt that by studying the specifics of a trait, general conclusions could eventually be reached. No overall theory or framework was ever presented.

**Developmental Research**

This differs from the approach used by Piaget. Piaget studied responsibility in terms of moral development, studying changes within the child as he moves from egocentrism and reaction to adult constraint to a morality based on cooperation and autonomy. Responsibility within this framework represents accountability – how a child would relate various moral situations or acts in terms of their gravity. Feeling clumsiness, stealing and lying to be issues of great frequency if not importance in the moral development of most young children, Piaget based his research on these three areas. He presented children with sets of stories – each set involving similar acts from the above categories, but with differing intentions and consequences – to be rated by them for seriousness. He then discussed answers and experiences with them to further clarify their views. In this manner he observed stages in a child's development. The very young child, he noted, cannot separate moral and physical law; rules come from above and are not to be changed. Since adults have frequently verbally responded in accordance with the extent of any particular mishap (although their moral reaction does not necessarily follow this pattern), the very young child tends to judge "wrongness" by this criterion. Thus the more ridiculous a lie or the more valuable a stolen or broken object is, the greater the wrong in commiting the act has been (objective responsibility). As the child gains in cooperation in his dealings with others, this quality tends to be replaced by a judgment stressing intentions over results (subjective responsibility). This shift in emphasis tends to come somewhere between the ages seven and nine or ten.

Aside from this very basic distinction, Piaget attempted to differentiate among a child's judgments, verbalisms and actions. The very young child may in his verbalizations be merely parroting what he has heard, in his actions express what he is learning and in this judgments reflect what he has already mastered. Thus it was not uncommon in his discussions with children for Piaget to find a child who judged others (in the presented stories) more harshly than himself (in personal experiences) – not necessarily because of any greater self-leniency, but because his own actions reflected changes in development which had not yet been adequately incorporated into his own cognitive framework for use in explanation. The children thus described appeared unaware of and unconcerned with any incongruity in their thought processes thus displayed. In this sense, the child appears to pass through three stages. At first he expresses a moral realism (objective responsibility) in both his actions and thoughts. As he matures he passes through an intermediate stage in which he behaves on a subjectively responsible level although he still verbalizes on an objective level. The final stage on this criterion is when the child achieves both verbal and actual subjective responsibility in his moral judgments. Although Piaget would feel these stages to be appropriate for all children, the specific ages of levels would tend to reflect those children he studies, most of whom were from very poor districts in Switzerland.

## Specific Aims

The present study was an attempt, using Piaget's method of presenting and discussing stories with children, to see if the efforts of Harris, Zunich and Walters at differentiation among children could be realized in a less structured and hopefully less artificial situation. In this case children from two ethnic groups, Negro and White, were studied. Only males were studied, and all were from the lower-middle class. Based on the findings of Hartshorne and May and their possible application to the Harris study (indicating that there may be no uniform trait of responsibility), two separate situational aspects (school and non-school, representing authority and peer group relationships, respectively), were studied.

Coleman, Harris and Piaget seem to agree that responsibility (subjective responsibility) develops best when its growth is motivated instrinsically, whether through tasks or experience. From this point of view, one might expect that a child would exhibit more of what Piaget terms subjective responsibility in whatever activities are more congruent with his life style. Differentiating between school and non-school tasks was an attempt along these lines. The hypothesis

was made that school is not as congruent with living experiences with blacks as with whites, and that therefore black children should be more likely to show subjective responsibility within the give and take of peer group relations. It was expected that, in accordance with Zunich's findings, black children would appear less responsible in authority type situations. White children, who have traditionally met with more success in school, were expected to show the reverse of this configuration. It was felt that showing the above hypotheses to be tenable could have importance in the individualizing of education. If children gain responsibility primarily from different types of experience by groups, it would indicate that perhaps different experiences should be stressed with these groups.

## Method

### Subjects

Thirty-two male third grade students, sixteen blacks and sixteen whites, from two schools in the Bay Area were studied. The schools selected were almost racially uniform and employed relatively comparable teaching structure and authoritarianism. The white school wqas parochial; the black school, public. The first is non-graded; the second has an open pod system for some of its students. The children studied were selected randomly (Dixon & Massey, 1969) from among the third grade boys in the schools, with a prior limitation to those born in the United States and speaking English. They were rated according to the Index of Status Characteristics (Warner, 1960) and teacher estimation to determine their approximate equal membership in the lower middle class. The boys selected were then divided randomly into two separate groups, divided equally black and white, representing the orientation, either school or non-school, of the stories they were presented in the study.

### Procedure

Each child was presented with four separate problem situation sets involving responsibility, as defined by Piaget.[1] In each set the motive and material results of an act were the stimulus, such that one story involved good intentions with extensive damage or result, and the other involved bad intent with minimal negative result (see Appendix). There were two story sets for each of the categories, clumsiness and stealing. The stories were made to be each the same length and their order of presentation, subjective or objective, was counterbalanced. Each child listened to stories with either a school (authoritarian) or non-school (peer) setting; these stories were basically the same, with a change of setting or object differentiating them. The dependent variable was gradation in terms of objective or subjective responsibility made by the child in discussing the stories, such that each child received a score according to the number of subjective story interpretations he made, ranging from zero to four. This was done in an attempt to quantify Piaget's method.

With each child, the procedure was the same. The examiner briefly explained to the child that she would be reading stories to him and would like to hear how he felt about them. Each child was told that there would be no "right" or "wrong" answers to the questions subsequently asked of him, and that the examiner was learning about children and hoped to find how different children, in different schools, viewed the stories. The children were told how they were scored, with no moral interpretation applied, after the session, if they asked. The entire procedure took about fifteen minutes with each child. There were no unwilling subjects; several asked for more stories after the initial four sets.

The examiner then read each story to the child and asked him to repeat it in his own words, to be sure of his understanding. The story, or parts of it, was then reread if necessary, for clarification. The child was asked if he thought the "hero" of the story had done anything wrong, and if he should be punished. After both stories of a set were read, the child was asked to name the greater wrong and to explain his reasoning. Whichever direction the child chose, the alternate, with reasons, was then presented to him, to see if he would change his mind. Alternate arguments (such as, "But the other boy *meant* to do something wrong") or summarizations (such as "One boy wanted to help his friend and stole something big, and the other wanted a little candy bar, so took it") were presented until the child was sure of his response. At some point during each administration each child was asked if he had ever been confronted with a similar situation such as trying to help someone and making a mess instead. He was asked whether he had been punished, and, if so, whether he thought the punishment was just. Almost all the children had had such experiences.

## Results

The children seemed sure of their judgments (less than five children altogether changed their mind on any story), and their responses generally fell into the patterns first described by Piaget. Typical of subjective responses was that of a black child, given non-school stories, "Keith should be punished 'cause he did it by purpose." Another child, given school stories said that an act was worse "cause he wanted it hisself and the boy who stole the lunch stole it for his friend 'cause he has nothing to eat." Various white children said "he was stealing for a good reason," "I don't think he meant it" or "no, just an accident" in regard to whether or not a person should be punished.

Objective responses emphasized the value of an object, and, frequently, the need or inevitability of punishment. An

[1] Two stories, from an original six, were dropped during pretesting to shorten the time of testing.

**TABLE 1**
**Mean Scores on Stories**

| | Black | White |
|---|---|---|
| School | 1.5 | 3.15 |
| Non-School | 2.15 | 2.88 |

**Figure 1**
**Mean Frequency of Subjective Responsibility**
**School vs Non-School**

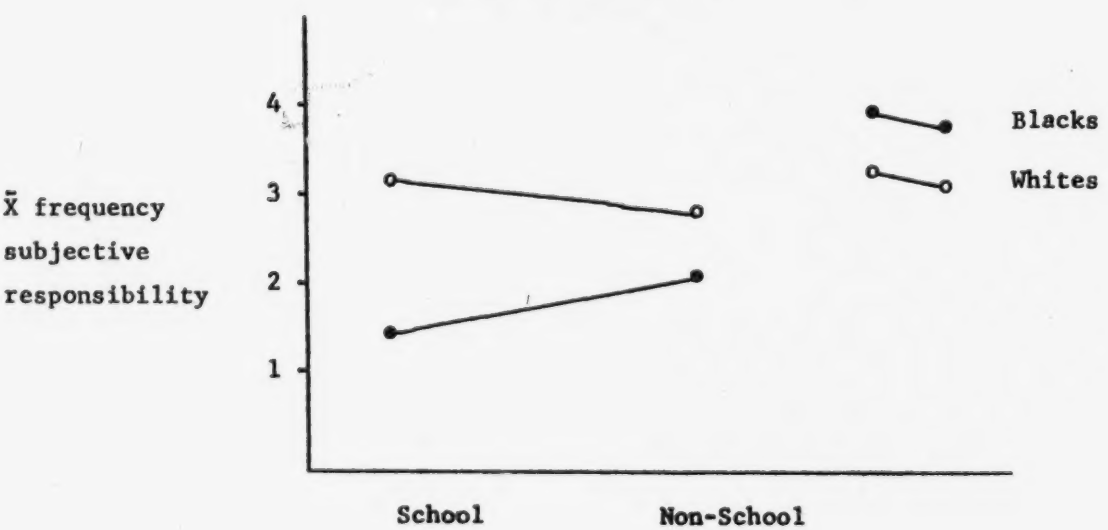

Figure 2
Mean Frequency of Subjective Responsibility
White vs Black

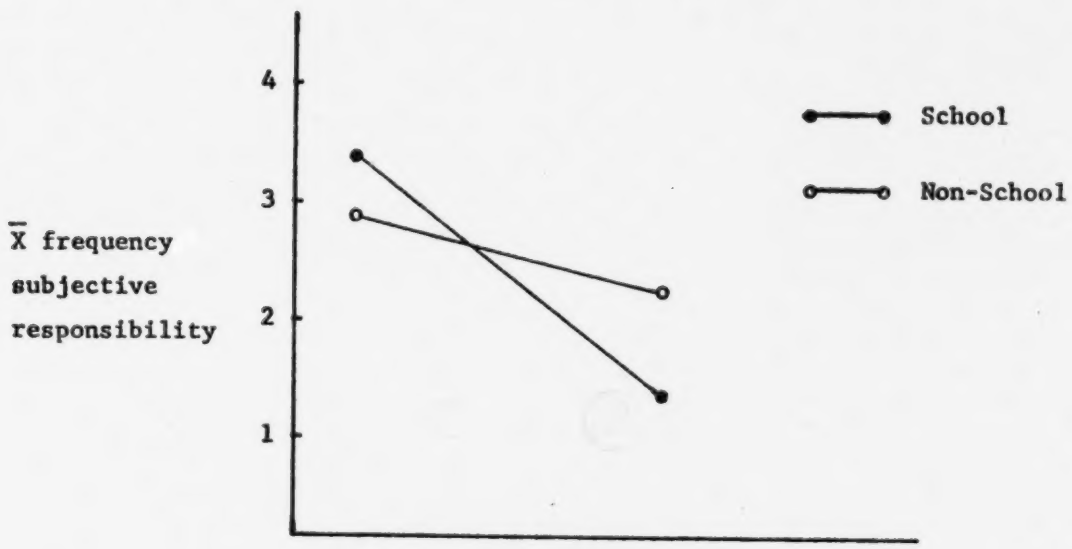


TABLE 2
Analysis of Variance

| Source | df | SS | MS | F |
|---|---|---|---|---|
| Situation (rows) | 1 | .28 | .28 | 1 |
| Race (columns) (White-Black) | 1 | 11.28 | 11.28 | 6.48** |
| S x R | 1 | 1.54 | 1.54 | 1 |
| Within | 28 | 48.62 | 1.74 | |
| Totals | 31 | 61.72 | | |

**p .05

example of this would be the response of one black child, given non-school stories, who said that it is worse to "let a monkey out of a cage (than steal a candy bar). You can't go to jail for a candy bar." Another child (also black, non-school) said "John worse 'cause a model airplane cost more money than a kite. It was John's fault 'cause he left it there." After the Examiner explained that he had not left it there himself, the child continued, "It was his fault 'cause he broke it." White children showed essentially the same response pattern, although generally without the stress on punishment. As one boy (white, school) said, when asked whether it is worse to steal a lunch for a hungry friend, or to steal a picture just because you want it, "lunch does something useful and a picture doesn't."

There were some original responses, such as the child (white, school) given the same story, who said "All he had to do was tell the teacher and she would have done something about it and he wouldn't have had to steal it." Another boy (white, school) said it is worse to steal a monkey than a candy bar, despite intentions, because a "monkey knows how to eat a banana(and) a candy bar ain't worth anything."

Most children had experiences similar to those in the stories; contrary to Piaget's findings, they judged themselves in the same way they judged the boys in the stories presented. An example would be one boy (black, school) who rated all the stories objectively. He said, "Once I stole something from the store. A little tiny piece of gum. Just put it in my pocket and walked out." When asked if he should have been punished, he said, "No, 'cause it was only a tiny piece of bubblegum."

**Scoring**

Each child in the study received a score, either zero or one, indicating whether not he responded subjectively to each of the four stories presented to him. This was determined according to whether he placed emphasis on the intentions or consequences in his judgment. These four scores were added together to form one score, ranging from zero to four for each child. A mean score for each group (black, school; black, non-school; white, school; white, non-school) was determined by adding the scores within that group and dividing by eight, the number of children in each group.

**Reliability**

A Spearman-Brown reliability test (Anastasi, 1968) was performed on the results to check interitem consistency and the predicted results had the original six story sets been used instead of four. On a split-half test the correlation is .82 between odd and even numbered stories. The correlation equals .78 for the predictive reliability of four instead of six stories, indicating, in both cases, a fairly strong correlation.

**Analysis** (See Tables 1 & 2, Figs. 1 & 2; Pgs. 24, 25)

The mean scores according to situation and race show that there were differences among the groups. These results indicate a trend in the direction of the hypothesis. Comparing the school and non-school stories, the study showed that there was a greater difference in response among black children than white, with whites consistently higher in subjective responsibility as measured.

Comparing white children with black children on the stories, white children tended to show greater subjective responsibility with school situations and black children showed relatively more with non-school tasks, as predicted.

An analysis of variance was performed to test the significance of these findings. Race differences were shown to be significant at the .05 level in frequency of subjective responses over all. No other comparisons, either the situational variable or the interaction proved to be significant.

## Discussion

**Limitations of the Study**

There are some important considerations that must be made in interpreting the findings of the study. All white children studied were from a parochial school, in contrast to the public school attendance of the blacks. This could have affected the scores in that parochail school attendance might be a reflection of greater parental concern about education or authority. One teacher at the parochial school mentioned having recently discussed moral issues and the possibility of an illegal act such as stealing being justifiable in certain circumstances. This could have been reflected in the higher scores of the children at this school.

The stories read to the children varied in tense, some being in the present and some being in the past. The effects of this extra variable were not studied.

Also, there was no test or equalization done on the severity of the stories. There is no question that the stories could have been manipulated to increase or decrease the likelihood of a subjective response. Most adults would think no wrong of a child who spilled his milk at the table while reaching over to catch an infant sibling who was falling off his highchair. Likewise, if a person felt a great respect for freedom and let the tigers loose at the zoo, few people would be sympathetic. In this study, the stories were the same across racial groups, equalizing this factor somewhat, but some were different across the situational variable and could have been thus affected. As a whole, this approach could mean that the differences perceived between the races could be caused by differing attitudes towards or experience with punishment rather than differing stages of morality. Responsibility is closely aligned with so many aspects of maturation and life style that it is difficult to specify exact causes for differentiation.

Above all, in interpreting the findings, emphasis must be placed on life style differences between the two racial groups of the study. Child rearing practices appear to differ, with a possibility that punishment is stressed more within the black population. The relative cohesiveness of the families was not considered as a variable in the selection of subjects. Once again the importance of the church must be mentioned as an extraneous variable. Genetic racial differences cannot be inferred from the results.

**Correspondence with Other Research**

The results of the study suggest that lower middle class white male children attain subjective responsibility before their Negro counterparts. Piaget determined that the transition from objective to subjective judgment occurs between the ages of seven and ten. Most of the children in this study showed both types of responses, indicating that they were in such a transitional period. Piaget indicated that parental training has an effect on the age of acquisition of the second stage; since the present study made no attempt to differentiate between genetic and environmental influences, the perceived racial differences in subjective responsibility could well be attributed to child-rearing practices and expectations. Further research would be suggested in this area.

The present study supported the view of Harris, Walters and Zunich, that the area of responsibility is a fruitful one for research, and this study succeeded in adapting the concerns of these investigators to the more uniform and theory-related framework of Piaget.

**Implications for Practice**

Teachers frequently are attuned to differing parental strategies for handling disobedience, according to or despite a child's intentions. They may base much of their school-home communication of student behavior or achievement with an eye towards its probably reception. This study corroborates this view by indicating the existence of differences between home and school responsibility as perceived by children and, perhaps, a need to make a child more aware of intentions for his acts. If the racial differences in the development of subjective responsibility are caused by child rearing practices, it would be advantageous for the black schools to attempt in some ways to counter-balance a fear of punishment (possibly quite realistic in some black communities), with a continued regard for the intentions behind an act and perhaps through some discussions with the children of such issues.

## Conclusions

The present study has shown that there are significant racial differences in the acquisition of subjective responsibility. These differences possibly may be due to differences in child-rearing attitudes and practices, suggesting an avenue for further research. No significant differences were found regarding children's perceptions of responsibility in home and school settings. The study showed that it is possible to adapt trait research concerns to a developmental framework.

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## Appendix

1. A little boy named John is in his classroom. He is called into the lunchroom. He goes in, but behind the door there is a chair and on the chair there is a tray with fifteen cups on it. John could not know that there is all this behind the door. He goes in, the door knocks against the tray, and the cups all get broken.

   Once there was a boy named Henry. One day when the teacher was out of the room he tried to get some paste, which was against the rules. He climbed up on a chair and stretched out his arm. But the paste was too high up and he couldn't reach it. But while he was trying to get it he knocked over a cup. The cup fell down and broke.

I. A little boy named John is playing outside his house. His friend calls to him from next door. He rushes over, but behind a small rock was his friends's new

model airplane which cost a lot of money. John couldn't have known this was behind the rock, and doesn't see it. He rushes over, but steps on the model airplane and breaks it.

Once there was a boy named Henry. One day when his friend was not around he borrowed his paper kite without asking. He tried to get the kite to fly, but there was not much wind. He ran very quickly so it would go in the air, but it got caught in a bush and got a little rip along the side.

2. Once there was a little boy named Keith. He was sitting in the classroom, and when the teacher left the room he thought he would play with the paints even though he knew it was against the rules. He took a brush to paint with and made a little mark on the floor.

   A boy, Darryl, once saw the small paint jar in class was empty. One day when the teacher was away he thought he would help her by filling it from the big one. He thought it would be a nice surprise for her. But he made a big paint mark on the floor when he opened the jar.

II. Once there was a little boy named Keith. He was at a friend's house visiting one day. His friend had to leave the room, and as he left, said don't touch my paints. Keith opened them as soon as his friend left, and made a tiny print mark on the floor.

   A little boy named Darryl visited his friend's house one day. His friend had been painting, and had left his paints out on the table. His friend had to leave the room for a minute. Darryl thought he would help his friend and put his paints away for him, but he spilled them all over the floor by mistake.

3. Alfred meets a little friend of his at school who is very poor. This friend tells him that he has no lunch today because there was nothing to eat at home. Then Alfred goes into the teacher's lunchroom and steals a whole lunch when no one is looking. Then he runs out and gives it to his friend.

   A little boy named San goes to school one morning. He sees a picture of a car cut out from a magazine which someone left on the teacher's desk. He thinks it belongs to the teacher. He wants the picture, so he waits until no one is looking and steals it.

III. One Saturday Alfred is in the park. He sees his friend. His friend says he has had nothing to eat all day because there is no food at home. Alfred steals some chicken from some girls who were having a picnic, when they are not looking, and gives it to his friend.

   A little boy named Sam visits a friend at his house one day. This friend shows him a new magazine he has; there is a small picture of a car inside the magazine. San wants the picture, so he waits until his friend is not looking and steals it and puts it in his pocket.

4. James was talking to his teacher one day at her desk when he saw that she had some candy bars in her desk drawer. He knew it was wrong to steal, but he thought that maybe no one would notice if just one was missing. When the teacher wasn't looking, he sneaked up to the desk, took one candy bar, hid, and ate it.

   Albert's class had a monkey in a cage. Albert thought the monkey must be very unhappy being in a cage all the time, and wanted the teacher to let it out, but she wouldn't. So one day when the teacher was out of the room, Albert went and stole the monkey. He hid the cage and let the monkey loose outside so it would never be locked up again.

IV. James was visiting his friend at his friend's house one day when he saw that his friend had some candy bars. James knew it was wrong to steal, but he thought that maybe no one would notice if just one was missing. When his friend wasn't looking, he reached over and put one candy bar into his pocket. Later he hid and ate it.

   Albert's friend had a monkey in a cage at home. Albert thought the monkey must be very unhappy being in a cage all the time, and wanted his friend to let it out, but he wouldn't. So one day when his friend was away, Albert went and stole the monkey. He hid the cage and let the monkey loose outside so it would never be locked up again.

Arabic numerals – school, authority situations.
Roman numerals – non-school, peer situations.

Abstract of Paper

**Planning Effective Preschool Programs:**
**An Application of the**
**Assimilation - Accommodation Concept**

Greta Morine

This paper defines four aspects of structure in the child's environment as: selection and organization of objects; selection and organization of operations and procedures; selection of people with whom child interacts. Each structure has a range or variance, labeled the adaptation continuum. The child's adaptation to each may be basically assimilation, basically accommodation, or basically intellectual adaptation (equilibration). Preschool settings are analyzed in terms of their ability to provide the child with an opportunity to adapt through equilibration. Suggestions are made for modification of settings to this end. The paper is excerpted from "Extending Preschool Programs," a chapter in *A Primer for the Inner-City School* by Harold and Greta Morine, McGraw-Hill, 1970.

**Acquisition of Some Relational Terms and Concepts:**
**Mother-Child Interaction and Social-Class Differences**

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Abstract

The present study examines social-class differences in the child's acquisition of some relational terms and concepts, the influence of the mother's relational terms on the child's acquisition of such terms, and the influence of mother's relational terms on the child's classification and seriation skills.

First-born kindergarten children with no preschool experience were classified into SES groups. An index of the mother's use of relational terms was obtained through a structured mother-child task; in addition, classification and seriation items were administered several days later to the children, along with questions to elicit their relational terms.

Correlational analysis of the data established that mother's use of relational terms predicted child's classification-seriation skill at a significant level. Social-class also predicted this skill, independent of the mother's relational terms. The child's classification-seriation skill correlated significantly with his use of relational terms, suggesting additional support for the interaction between a child's language and thought development. The mother's use of relational terms, however, did not predict the child's acquisition of these terms, as it did with his associated cognitive skill. No significant correlations were noted of SES with the proportion of spatial to nonspatial terms; the higher the child's social class, however, the higher his ratio of seriation score to classification score.

The follow-up data showed that the lower the mother's index of relational terms, the higher the child's gain score for these terms following kindergarten entry. No significant relationship was found between the mother's use of terms and the child's gain in classification-seriation skill.

In general, this study suggests that the mother's language can significantly influence the child's cognitive skills, independent of social-class. Social-class differences in the child's acquisition of terms and concepts may appear, however, independent of the mother's language.

# A Child's Cognitive Conquest of Space and Time[1]*

Henry W. Maier[2]

**Introduction**: A Space station in orbit can be understood and visualized by most of us only with the aid of a diagrammatic or real miniature models. This dependence upon concrete models, Jean Piaget would assure us, does not signify a deficiency in our mental capacities. To the contrary, we are following the natural developmental process every child and adult must go through while learning new and more complex concepts on spatial and temporal relationships.

Jean Piaget, one of the most creative child developmentalists of our time, has devoted his life's work to the study of the embryology of human thought processes, including the development of a child's cognition of space and time.

On the following pages we shall summarize and interpret Jean Piaget's research on the development of the concept of space and time, and to relate them to the concomitant and intertwined development of cognitive and affective processes. It is hoped that Piaget's theoretical material can be readily related to our work with children.

**A Timeless and Spaceless Existence**: In tracing the development of a child we learn that the very young child sees himself and the world around him without an awareness of spatial and temporal boundaries. He operates appropriately in space and time without cognition of these dimensions. The eventual awareness of space and time is always preceded by sensory perception of and by life experience with it. In short, the very young child exists in a world free of spatial and temporal problems. His belief in Santa Claus presents no problem. His Santa can deliver all gifts simultaneously throughout the world within the same midnight hour. Or, without reliance upon schizophrenic processes, the child can "fly" on his tricycle to any place he specifies. Such freedom from spatial problems explains a child's genuine surprise over spilled milk, when he pours a full glass of milk into an obviously so much smaller cup.

The First Ordering of Space: Fundamental by Proximity: All first ordering of space (and later time) occurs by the most *primitive* law of relationship, the *law of proximity.*

The law of proximity parallels the early childhood psychological state of egocentric existence with absolute self-reference as the way of life. Frequently, a child will employ the words of his elders, although the meaning of his words is anchored within the content of his egocentric frame of reference. He may be apt to state: "I want more too much." or, "I come in a minute." The young child has no concept of time. *Before* and *after* are seen as features of every experience but not as a temporal reference points. For instance, "I play outside and daddy comes home." or, "I sleep – read me a story." Spatial or temporal events next to each other belong to each other.

*The Second Ordering of Space and Time – by Separated But Proximate Units:* As the child gets older his subjective experiences lead him to locate spatial phenomena within single self-contained units. He discovers openings as an interruption of space. Although he has played long before with openings, crevices, and other spatial units, the child now concerns himself knowingly with them as separations. (He proceeds to act by *the law of separation.)* Awareness of separation coincides with an acceptance of psychological and physical boundaries. On the other hand self and other objects are dealt with as separate units; on the other hand proximity assumes new meaning: proximate factors become united into single units, these units are separated from and compared with other units.

Note that this new phase in the child's conquest of space coincides with a different approach to daily problems in his style of daily living. Life events are not perceived for their sequential or proximate characteristics; the child at this point of life tackles his experience *globally.* He establishes his boundaries first by getting hold of the ends. He relies upon simple topological relations. He concerns himself with openness and closure as well as the proximity and separation of objects or events. We witness that the psychological development tasks are intertwined with the problems posed by spatial and temporal conditions. Life experiences, including his play, result in the constant combination of proximate factors and the creation of new units. To illustrate, the young child's block play proceeds primarily by his using the blocks located nearest to him and next to each other. Or, to illustrate further, wherever a doll is put to rest (on the rug, on a pillow, or in a box), such a resting place becomes established as "dolly's bed." One handful of sand piled up becomes a *mountain,* regardless of the surrounding terrain within the sandbox.

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*Some editorial revisions were made to update the material in this copy.

[1]Paper delivered at the Annual Meeting of Orthopsychiatry at San Francisco, California, April 1, 1959. (Also published in *Journal of Social Research,* Vol. II, #2, July, 1961, p. 31-38.)

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*The Third Ordering of Space and Time – by a Single Reference Point:* The young preschool child starts "to conquer space" and begins to gain a primitive notion of time the moment he can conceive of a *single fixed* reference point for several units or events – even if each spatial unit is perceived as independent and separate systems. These cognitive states are not much different from his psychological sense of belonging. The child at this age is apt to state: "I have a mother, a father, a sister, and a family." The child estimates and deals with *one* spatial quality at a time. He judges by a single dimension and employs *a* single reference point. He uses a single measurement for spatial judgment such as big, large, or full. Therefore, the well-known experience of a four-year-old choosing a large nickel in preference to the smaller dime does make sense. A child's preference for a glass filled to the brim to other glasses not filled to the top regardless of the sizes of the glasses illustrates again that a single reference point, "fullness" in this instance, serves as *the* clue for his judgment.

This last example stresses that *the end stage* of the child's experience with spatial relationships serves as his overall and globally applied point of reference. Note that it was the state of fullness of the glass of milk which provided the basis for judgment although he witnessed milk being poured into each of the two glasses. Quality, quantity, or speed is judged by its single, final spatial condition. We all know incidents where the size of a gift became all-important in spite of our attempts to point out other qualities of a much smaller (in size) gift.

*The Fourth Ordering of Spatial and Temporal Experience – As A Single Interconnected Sequence:* The moment a child's thinking reflects ordering and ranking, he starts to think and to reason at a more advanced level. The child's continued experience with different spatial dimensions and events, which occur within each other's proximity, lead him to locate eventually a series of relationships with a fixed reference point – usually the final or most overwhelming condition. The child's first notion of an orderly sequence evolves to a definite understanding of the elapse of time – a first recognition of a *temporal* condition. This simple concept is established by judging single spatial end results. For example, the first child to report that his work or play is done is considered the quickest child regardless of the amount of work or play completed by any of his "competitors."

It should be emphasized that it is awareness of the elapse of time and not the time period which provides the first temporal concept. Recognition of this development factor may lead to a clearer understanding of the young child's approach to his everyday experience. The common question: "When will I be done?" or, "When is supper?" frequently finds such meaningless answer (that is, meaningless to the child). "In ten minutes!" or, "In a little while" while he would have understood a statement such as "You will be done when all the blocks are picked up," or, "Supper is ready when the soup is on the table!"

In the activities of young school age children we witness a whole range of new spatial and temporal experiences. These children start to relate consciously to multiple properties of space. In their activities and in their speech they experience and organize spatial properties. For instance, while playing spaceship, children of this age group tend to place several pieces of furniture together. They bestow spatial properties upon these pieces of furniture. (At this stage one single chair will no longer do. Several objects have to be spatially arranged and specifically endowed with several spatial and causal qualities such as size, shape, weight, and power.)

*The Fifth Ordering of Spatial and Temporal Experience – by Two Reference Points:* Continuous new experiences and reflection upon these experiences do widen the child's perspective. He gains awareness of the fact that quantity and quality can be maintained within the same unit while relationship patterns change. In other words, milk, although poured from a small container to a larger one, does not change in quantity. Or, two individuals can perform the same amount of work in different lengths of time. Symbolically, it means that the child can work simultaneously with at least two different points of reference. The child acquires a concept of order and the idea that he can start measuring anywhere. In short, experiences take place in an *ordered* world with well-defined boundaries and distinct interrelated and interchangeable units.

As stated, the individual can now envisage any spatial relationship within the "whole" and the "whole" in relation to a larger unity or system. The child finds a sense of certainty in his spatious world. He secures his own anchoring point within a changing field of relationships. He can order and classify his life events as they occur. In everyday life, it means that a child can initiate a game of baseball from any one corner of the playground. First base can be established on yesterday's home plate, or, the pitcher's box and outfield can be set up in appropriate new locations without creating a sense of bewilderment or a feeling that a revolution has taken place. In short, the child can now start his play, his work, or his wandering from any *known* place and get to any other known place in any sequence he desires.

Awareness of relationships, however, still rests upon two simultaneous variables. The roughly eight year old child, as we all know too well, still comprehends only parts *or* the "whole" at one time. Likewise, he can compare only two separate variables at a time. All ordering has to be with the aid of concrete experience. We can easily visualize the child fingering each piece of candy before he can make his choice. On other occasions, he must handle most of the toys on the playshelf and compare them one by one before he can make his play choice. In eaxh instance the child chooses on the basis of the physical manipulation of the

two adjacent alternatives in order to establish which is the larger and consequently the more desirable. He orders step by step, quantity by quantity. And as he matures, the child establishes a series of hierarchy of symbols which represents these manipulative experiences.

These findings point out the potential meaning of children fingering objects, gesturing, and talking out their experiences, while they think out the tasks before them – which more often than not include problem-solving of spatial and temporal questions.

Classification, seriation, and hierarchial order bring together within one reference system previously independent qualitative – quantitative relationships. We alluded earlier to Piaget's findings that length, heighth, or similar single measurements serve as the first quantity for any qualitative judgment. A year later weight can also serve as a separate and eventually as an additional factor in ordering objects or events. Around the age of eleven the child tends to deal knowingly with such multi-dimensions as volume, duration, and speed.

These new conceptual conquests of spatial relationships, Piaget stresses, finally pave the way for the understanding of time, as such. Slowly, the passage of time becomes a comprehensible measure. Periods of time are recognized as the progressive structuralization of such concepts as equal distance, duration, and speed. The child now becomes preoccupied with events which deal with problems related to the development of temporal concepts. He gains a notion of the *meaning* of such abstraction as speed, duration, or distance. In other words, not until this point in the child's development does such an everyday comment as "I'll be with you in a minute," have any real meaning. We must assume that previously such a comment meant nothing else to the child but "Wait till I come to you," or, "Wait until you are called by me."

*The Sixth Ordering of Spatial and Temporal Experience – by Several Units as Part of a Whole and the Whole for its Parts:* Ordering of relationship eventually guides the child to an awareness of whole patterns of relationship. The child, now approaching adolescence, can handle most of *his* tasks before him as long as they are within his plane. Symbolically, the pre-adolescent's thinking is confined to an Euclidian space. He can only tackle relationships with a single perspective. In daily life, objects or events are appraoched from a single perspective, while experiences (or ideas) with several perspectives still remain confusing. For instance, it is difficult for such a child to comprehend that different makes of cars can exist parallel to each other without establishing a most desirable car and a semblance of a hierarchial structure by which he can relate himself to all of the different makes and types of cars under his surveillance. The child must locate a single anchoring point and proceed with an understanding that there is a largest car: a fastest, a best made, and so on. Figuratively, the youth continues to evaluate by a *single*, measuring stick. The difficulty of having only one reference point is starkly reflected in the competitive striving of individuals, as members of a team, club, or gang. This need for a solitary reference system, for "one point of view," is also brought out in the child's stories, in his unsophisticated reasoning and in his self-centeredness in his daily life experiences.

*Ordering of Several Units and Their Wholes by Their Relativity and Implication:* Each shift in reference point and each new experience with symbols of previous concrete experiences furthers the child's abstract thinking. Above all the adolescent youth gains awareness that previously established relationships continue even with his new points of reference. Schematically, events can be related to each other horizontally as well as along a previously recognized hierarchial order. The adolescent can now deal with relationships of two different ideas. He gains cognition of the continuance as well as constancy of any one independent idea from the very perspectives of others. In brief, the adolescent finds himself projected into a multi-dimensional world of relativity – a world of perpetual motion and with unlimited perspectives.

Henceforth, the adolescent must conquer a new world. He must establish his own boundaries, his own spatial and temporal limits, because all previous anchoring points, he realizes, depended upon his particular vantage point *and* those of others. Consequently, the adolescent is in a constant state of experimentation. His behavior is quite different from his earlier childish play activities. He no longer depends upon the manipulation of objects and experiences, he can deal with them mentally – by reasoning, and above all, by verbalization. Thinking aloud, or in other words: *talk* becomes the adolescent's means for discovering more clearly his new and more complex world with which once he could only deal actively. He reviews questions from all angles or from many perspectives pertaining to relationships, real problematic, or apparently irrelevant ones. His questioning and manipulation of ideas and ideals from many reference points seem to be part of his total effort to find a place under changing conditions and relationships. He seeks a new spatial and temporal place for himself, first within his immediate world, later in a world with ever-extending boundaries. In contemporarily psychological terms, he finds a *sense of identity*.

To return to a previously unsolved problem, the adolescent eventually is apt to solve the question of the co-existence of different makes of cars without a single hierarchial system, whenever he manages to reason by relationship patterns and by implication. Spatial or temporal conditions can be interrelated independently from each other in variant proportions. In short, the maturing adolescent learns to use his space and time *flexibly*. He now has moved into a world of relevant relativity.

*Differential Rate of Development of the Various Processes*

*of Cognition:* Piaget's research further reveals that the individual operates with different levels of development throughout life. First, a child lives and proceeds by certain spatial and temporal laws without necessarily comprehending them. He operates *as if* he knew. Usually, it takes more than a year in an individual's development before he can *comprehend* the processes which he already included in his mode of reasoning. Again, only after a considerable lapse of time, usually more than a year, can he verbalize his understanding. And still much later can be logically demonstrate and explain his rational judgment. In work with children and youth caution must be exercised in a demand for reasonable descriptions and explanations of their thoughts. A child's helpless retort, "I don't know where to put it!", in spite of his actions to the contrary, might contain more truth than we have been willing to admit. In other words, a child might readily act *as if* he understands. He might even describe his actions *as if* he understood their implications. However, by more detailed questioning, he may reveal that in action and even more so in explaining his action he is not yet capable of rational understanding.

This progression occurs with the development of each major order of concepts. On each level of understanding the individual first applies his new mode of thinking to immediate and familiar questions. Newer and more complex or remote problems are not approached on the same level until later on, – frequently, not until familiar experiences are already handled on a more advanced level. Added understanding depends upon added experiences and comprehension of earlier concepts. To illustrate, the previously cited problem of accepting different makes of cars beyond a single qualitative-quantitative measuring system will re-occur around more distant and more complex relationship patterns. Earlier we referred to our difficulties in understanding new dimensions within outerspace. Similarly, we could cite, in the field of international relations, our struggles with such a multi-dimensional problem as the comprehension of the relationship patterns of nations in the field of international relations.

*Implications of Piaget's Findings:* Piaget's research findings as applied above, reveal a developmental continuum parallel to other psychological growth. The material intorduces developmental problems concerning the gradual cognition of space and time. These problems seem to be intimately intertwined with psychological ones – such as ego development within a social matrix. Such interrelationship between finding one's psychological and one's spatial-temporal boundaries suggests that in the study, assessment, and treatment of individuals, emotional and cognitive aspects deserve consideration. In other words, a child's comment or action signifying that he does not understand or comprehend a situation may really mean: he does not understand it in a way as his adult conceives it! This material challenges a clear differentiation between "resistance" and "just not comprehending."

These illustrations challenge us to initiate additional research in the use of such projective material as Draw-a-man or similar tests. Verbal or hand-drawn images of a "normal," disturbed or psychotic child may reflect as much a message of his level of cognition as his projection of affective relationships. We should ask: What level of understanding is reflected by the individual's spatial configurations? Intuitive? Concrete? Communicative? Logical?

Essentially, however, this brief sketch of the development of concepts of space and time supports our understanding of ego boundaries. It would seem that ego psychology and Piaget's theory of cognitive processes supplement each other. They establish mutually inclusive concepts which deserve further elaboration for an understanding of the child's changing concepts of space and time, from an infant born at a time into expanding space to an adult challenged to master his space and time.

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## Cognitive Controls in Children and Performance on Piagetian Conservative Tasks

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The purpose of this research study was to investigate the relationship of field independence-dependence and verbal mediation-nonmediation in Kindergarten, first and second grade boys to performance on Piagetian conservation tasks.

Three hypotheses were projected:

1. Field independent boys will have grasped the principle of conservation to a significantly greater degree than field dependent boys.
2. Verbally mediating boys will have grasped the principle of conservation to a significantly greater degree than nonmediating boys.
3. Verbally mediating, field independent boys will have grasped the principle of conservation to a significantly greater degree than any other group.

88 boys were used from seven elementary school classrooms (28 kindergarteners, 30 first graders and 30 second graders). Each of the boys was tested individually in two separate sessions. During the first testing all 88 boys were given the Children's Embedded Figures Test to measure field independence, and the Kendlers' reversal-nonreversal shift task to measure mediation. For the second testing, the Concept Assessment Kit-Conservation was used to measure the ability of each boy to conserve; the scores of the boys on this test were used as the response measure for testing the hypotheses.

Due to the unequal cell sizes in the design, a three-way irregular analysis of variance had to be employed. The main effect of Field Independence was significant as hypothesized ($p < .01$). Grade was also significant at the .01 level. But the Verbal Mediation main effect, which was hypothesized to be significant, had an F ratio of less than unity. The predicted Field Independence by Verbal Mediation interaction also proved not to be significant. Neither of the two other first order interactions was significant, nor was the second order interaction significant.

The strong relationship between field independence and conservation in children substantiates the idea that this cognitive control influences the quality of performance on conservation problems. The significant main effect of Grade further substantiates Piaget's findings to the effect that conservation is a developmental concept directly related to age.

Two possible reasons were given for the lack of significance of the Verbal Mediation main effect: (1) Verbal mediation may not be related to conceptualization and (2) There were not enough nonmediators in the sample to draw sound conclusions about the effects of verbal mediation upon conservation behavior.

# The Development of Young Cerebral Palsied Children According to Piaget's Sensorimotor Theory

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A current approach in the study of early mental development is concerned with the dynamic process by which intelligence develops. Emphasis is upon continuous interaction between the child and his environment, and upon the importance of stimulus variation and adequacy. The leading exponent of this point of view is the Swiss Zoologist, psychologist and epistemologist, Jean Piaget. Based on observations of his own three children, Piaget (1952, 1954) reasoned that each advance in an infant's sensorimotor behavior must represent an advance in his understanding made possible by his own experience. Therefore, the mental growth of the child is seen as reciprocal interaction of experience and understanding which begin from birth and evolves progressively through distinct stages. As Woodward (1963) expressed it:

> Piaget's interest lies in the kind of psychological operation that leads to a result rather than in the fact of success or failure alone, and the aim of the investigation is to interpret behavior and not merely to make an inventory of items that appear at successive ages . . . . Since the important feature is the order of steps and not the age at which they are attained this approach can be applied to individuals whose rate of development is extremely slow. (p. 297)

Piaget's sensorimotor theory appears to provide a conceptual framework from which to study the behavior of children who may be retarded in mental and physical development.

One group of children whose developmental processes are not clearly understood are those identified as cerebral palsied. Cerebral palsied children present a varied and often complex picture of problems and disabilities. The manifestations of impaired neurological function may be observed as a variety of neuromotor, intellectual, sensory, and behavior signs and symptoms singly or in combinations and in varying degree (Denhoff & Robinault, 1960). In the early stages of development, it is often difficult to define clearly each individual case, because the neurological signs and symptoms change as the nervous system matures. With this in mind, all aspects of assessment must be approached with caution. Considering the complexities involved in the diagnosis of a young cerebral palsied child, Illingsworth (1962) stated:

> There is no short cut to developmental assessment. It can only be done against a thorough knowledge of the normal and of variations from normal. It must be based on a careful detailed history, physical and developmental examination and interpretation of the findings against the background of knowledge of the difficulties of prediction. (p. 40)

One of the greatest problems facing those concerned with the education and treatment of the young cerebral palsied child is the assessment and evaluation of the child's mental development. The traditional approach has been to use standard intelligence and developmental tests. The often used infant tests are usually based on physical and motor development, which penalize a child with a motor handicap. Furthermore, the predictability of infant test for later intelligence measures has been seriously questioned by Bayley (1958); this criticism seems to be even more valid for early prediction of a cerebral palsied child's intellectual future.

Piaget addressed himself only to the process of development in the normal child. Other researchers (Woodward, 1959, 1963; Garfield & Shakespeare, 1964; Tabary & Tardieu, 1963) have attempted to apply his theory, especially of the sensorimotor period, to observation and evaluation of atypical children. Their results have been encouraging and warrant further research on similar populations. To date, none of the reported studies has concentrated on the young cerebral palsied child who is chronologically within the sensorimotor period of development as defined by Piaget (1952, 1954). Therefore, with the personal encouragement of Woodward (1967) and the recognized need for new approaches in the assessment of the young cerebral palsied child, this present study was formulated.

## Purpose

The major purpose of this study was to determine the applicability of Piaget's sensorimotor theory to young cerebral palsied children. The main questions to be answered were:

1. Do cerebral palsied children develop sensorimotor intelligence and object concept in the same sequence as normals, as defined by Piaget's theory?
2. Does sensorimotor intelligence and object concept have parallel development in cerebral palsied children as Piaget found in normals?
3. Are there differences in stage level development when cerebral palsied and normal children are compared on the basis of intelligence ratings?
4. Is it feasible to construct a reliable research instrument, based on Piaget's sensorimotor theory, to assess the stage level development of cerebral palsied children?

Other more specific questions considered the functions of chronological age, intelligence ratings and motor disability in relation to assessment results.

**Procedure**

The various sensorimotor schemata that Piaget (1952, 1954) observed in his own three children as they encountered and accommodated various objects and situations provided the framework for the research instrument. In addition, from the research design and procedures already established by Woodward (1959), and from the studies of Escalona and Corman (1967, 1968), Kohlberg (1958), and Uzgiris and Hunt (1966), specific stage level items, methods of administration and response criteria were incorporated into the instrument for this present investigation.

The two major aspects of the sensorimotor period included in this study were: (1) sensorimotor intelligence and (2) object concept development. Study of causality and the spatial and temporal fields, which are other aspects of this period, were not included in this study.

Sensorimotor intelligence, which deals with modification of elementary behavior patterns into more complex ones, constituted Part I of the instrument. Appropriate observations and problems related to the development of sensorimotor intelligence were selected for the six stages as defined by Piaget (1952). The other category, object concept development, which concerns the child's knowledge of the objective world, and parallels the development of sensorimotor intelligence, constituted Part II (Piaget, 1954). Since object concept behaviors are not clearly defined in the first two stages, the sequence of schemas were designed only for stages III through VI.

Using a preliminary form of the research instrument, a pilot study was carried out on five CP children, enrolled in the UCLA Cerebral Palsy Prenursery Program, whose functional handicaps ranged from mild to severe. Purpose of the initial study was to determine appropriateness of test items in relation to motor handicap and interest in test materials. As a result, the instrument with procedures and scoring criteria was put into final form.

Subjects for the major study were 10 normal and 20 CP children between 18 and 36 months of age. The CP children were further divided into two groups of 10 on the basis of gross intelligence ratings, and were classified as "rated-not-retarded" and "rated-retarded." All CP subjects were enrolled in special nursery school programs located in Los Angeles County.

The investigator administered the final form of the Piaget Sensorimotor Research Instrument to all subjects on a test-retest schedule. For purposes of final analysis each item attempted was scored as pass or fail; notes were included on the details of the behavior observed in the performance of each item. On the basis of the final results; subjects were classified according to the highest stage level reached for: (1) sensorimotor intelligence and (2) object concept development.

**Summary of Results**

Results indicated that: (a) the Piaget Sensorimotor Research Instrument had reliability for the total sample; (b) normal and CP children demonstrated the sequence of stage level development as defined by Piaget, but, as shown by the CP rated-retarded group, the rate of progress was not the same for all children; (c) for normal and CP children, level attained on sensorimotor intelligence corresponded to level attained on object concept development; (d) quantitative results indicated that normal and CP rated-not-retarded were similar in performance, while qualitative results suggested that there were differences; (e) CP rated-retarded were significantly lower on the intelligence rating and the two Piaget measures than the CP rated-not-retarded.

**Discussion**

Evidence for and against Piaget's theory of intellectual development bears upon the concepts of stage and sequence of development. He postulated that during the sensorimotor period, the child progresses through six major stages of development which are attained in a sequential order. According to Piaget, each stage can be defined by characteristic behaviors, the behaviors of one stage serving as the foundation for the stage to follow. Other investigations (Escalona & Corman, 1966; Gouin-Decarie, 1965; Uzgiris & Hunt, 1966) have confirmed Piaget's postulation of stage order development.

Woodward's (1959) study, which served as the impetus for this present investigation demonstrated that older mentally retarded children followed the normal sequence of stage development in that they displayed characteristic behaviors for all stages prior to the highest level reached. Another major finding of Woodward's study was that there was a relationship between sensorimotor intelligence and object concept development. Woodward found that the level attained on sensorimotor intelligence corresponded to the level attained for object concept for the majority of severely retarded subjects.

Results of the present study support previous findings in confirming the stage sequence and parallel development of sensorimotor intelligence and object concept abilities. This is particularly interesting in that the subjects in this study included very young, seriously disabled children as well as young normal children. Woodward's study also dealt with atypical children; her subjects older mentally retarded, nonphysically handicapped children. Despite sample differences in diagnostic classification and age range, there is enough similarity of findings to conclude that Piaget's theory of sensorimotor development appears to be applicable to atypical children of different ages and with different developmental problems.

The findings from the small normal sample used for this present study supported Piaget's theory as well as being

consistent with the independent studies of Escalona and Corman (1967), Gouin-Decarie (1965), and Uzgiris and Hunt (1966).

From an overview of the various findings of studies based on Piaget's sensorimotor theory and from the results of this present study, there is positive evidence to support his concepts related to stage levels and sequence of development for normal as well as atypical children. However, performance of the mentally retarded and cerebral palsied groups indicated that rate of progress through the stage sequence was not the same for all children. This evidence does not negate Piaget's theory; it emphasizes the importance of the processes of sequential development rather than the age at which the stages are attained. The Piagetian formulation provides a means of placing children on an ordinal developmental scale which avoids traditional age comparisons. Piaget provided little normative data for chronological age comparisons. The ages quoted by Piaget for the beginning and end of each stage are suggested as average ages, but they are only approximate. Such factors as maturation of the nervous system, the child's experience of physical objects, and his social interactions are considered more meaningful determinants of development than chronological age (Woodward, 1963).

Inspection of quantitative results of the present study reveals that performance levels for normal and CP rated-not-retarded were similar while CP rated-retarded were significantly lower. This raises an important question in regard to the normal and CP rated-not-retarded groups. If a child's rate of development is influenced in this early period by the type and amount of motor interaction with the environment, as Piaget (1952, 1954) postulates, it would be presumed that a child with a motor disability would progress at a slower rate than a normal child through the developmental sequence. On the basis of the quantitative scores of normal and CP rated-not-retarded subjects, it appears that CP rated-not-retarded subjects were not seriously affected by the motor disability. The implication, therefore, is that motor interactions with the environment are not as important as Piaget believes them to be in the process of intellectual development. However, Piaget emphasizes that development must be evaluated from both qualitative as well as quantitative aspects of performance. For Piaget, the methods and styles of problem solving and the types of behavior observed are as important as the end result. His aim is to interpret behavior and not merely to make an inventory of items of behavior that appear at successive ages.

On the basis of the examiner's subjective observations, consistent qualitative differences were noted between groups of normal intelligence. The CP sample, by comparison to the normal sample, exhibited: slower rate of response to problems; need for more trials in problem solving tasks; more limited range of interactions with objects and toys; lower level of frustration tolerance; and the need for more encouragement from the examiner to attend to tasks at hand. The normal subjects in general showed a qualitatively higher level of response in terms of rate of problem solving, more sustained interest, and a wider range of interactions with objects, toys, and the examiner. It must be emphasized that in order to draw conclusions from the performance of individual children, the qualitative as well as the quantitative results must be considered. When various disability and nondisability groups are compared, as in the present study, the objective or quantitative findings of stage level accomplishment must be tempered by the qualitative findings which describe process. Although the CP rated-not-retarded group reached stage levels at the same rate and age as the normal group, qualitative differences were marked. Thus, although severe motor disability did not affect the quantitatively measured level of development, there were important aspects of process which appeared to be negatively affected by the motor limitations. The cumulative affects of such limited interactions with the environment cannot be determined in the present study because of the restricted age range of the subjects. However, the qualitative observations suggest that CP children of normal intelligence may have limited and sometimes inadequate sensorimotor bases for optimal development. The qualitative findings also suggest the need for incorporating more intense and extensive sensorimotor activities and experiences into therapeutic programs in the early years.

Piaget has suggested that the various schemata at any given stage level may be achieved through a variety of interactive experiences with the environment. The nature of the motor disability of CP children restrict markedly the range of experiences which develop normally for nondisabled children. CP children's "incidental learning" may be seriously minimized by their physical limitations. The kind of quantitative and qualitative evaluation derived from the Piaget scale developed for this study allow specification of the level of activity which the young CP child needs. Therapeutic programs could be developed to provide a broad spectrum of experiences and interactions which are directed at specific stage levels rather than a global behavioral level. It seems probably that CP children need more, not fewer, experiences at each level to allow solid development and consolidation of schemata at each stage. The fact that a child is able to achieve in some tasks at a given level, or to function at that level in terms of quantitative measures, but still show qualitative deficits, suggests that the CP child needs more and broader experiences at the basic sensorimotor stages before being presented with higher stage level tasks. The value of a diagnostic instrument is in part the direction it gives for remedial procedures. The Piaget instrument used in this study appears to have potential in terms of specifying the particular stage level at which a given child is functioning; it therefore provides a basis for educational and therapeutic planning.

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# Application of Piagetian Theory to the Development of the Concept of Space in Visually Limited Children

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The knowledge and understanding of developmental spatial concepts are indispensable aspects of the education and psychology of visually limited children. When children have low vision, either a concommitant lessening of spatial efficiency may be expected or else a tremendous amount of adaptation must take place in order to compensate for the visual loss.

According to Piaget, the essence of spatial intelligence lies in the individual's reasoning abilities which are defined in terms of mental operation. Initially the child develops concepts of space through establishing relationships between experience and action, through manipulating the world by action, and through learning how to represent the external by means of trial and error. Upon learning to use emerging operations as a means of solving problems, the child still relies on the concrete; he uses the present as immediate reality and is unable to cope with alternate possibilities. It is only after the integration of several thought processes into a system of reference can the child use formal operations. At this level he is now operating on hypothetical propositions rather than on just what he experienced. Table 1 shows the development of representative space.

TABLE 1
DEVELOPMENT OF REPRESENTATIONAL SPACE

A. Sensorimotor or Perceptual Space (0-24 months)

1. Reflexive and Primary Circular Reactions (0-4.5 months)

   Neither perceptual constancy of shape and size nor permanence of solid objects exists; absence of visumotor coordination.

2. Secondary Circular Reactions and Coordination of Secondary Schema (4.5-12 months)

   Shapes and dimensions of objects – development of perceptual constancy in size and shape; beginning of reversibility of movement.

3. Tertiary Circular Reactions and Invention of New Means through Mental Combinations (12-24 months)

   Relationships of objects to each other – emergence of mental image (symbol) with first attempts at drawing; space is no longer purely perceptual, but becomes partly representational.

B. Pre-Operational Space (2-7 years)

   Piaget and Inhelder (1967) describe the preconceptual, intuitive level as the transition between percpetual/sensorimotor space and spatial representation of the image. Slowly from the ages 2 to 7 representations begin to refer to more complex physical actions and to coordinate these among themselves, giving rise to rudimentary and isolated transformations – internalization of spatial schemata.

C. Representational Space

1. Concrete Operations (7-11 years)

   Thought now disengages itself from the necessary limitations of the images; the internalized action becomes mobile and reversible; operations are still concrete, dependent upon the presence of the manipulable object (real or represented).

2. Formal Operations (11+ years)

   Internalized action which no longer requires the object – completely removed from real action. The possible condition the real. System of references complete for global thought. Child operates on hypothetical propositions.

## Spatial Relations

Piaget and Inhelder (1967) maintain that fundamental distinctions exist between perceptual/sensorimotor space and representational space. Perception is the knowledge of objects resulting from direct contact with them. Representation or imagination involves the evocation of objects in their absence or, when it runs parallel to perception, in their presence. It completes perceptual knowledge by reference to objects not actually perceived.

Both sensorimotor and representational space develop according to three major types of spatial relationships (Table 2)

**Topoligical space** is the most primitive form and depends upon qualitative relations inherent in a particular figure. Topological relationships include:

1. proximity (a point belongs to each of its neigh-

bors); 2. separation (elements which are distinguished or separated); 3. order (a synthesis of proximity and separation); 4. the relationships of surrounding or enclosure; and 5. continuity and discontinuity. These topological principles are primitive in that they are purely internal to a particular figure whose intrinsic properties they express. Except for the factor of continuity and discontinuity, they do not express the relation among figures in a more complex field.

**Projective space** takes account, not only of internal topological relationships, but also of the shapes of figures, their relative positions and appraent distances, though always in relation to a specific point of view. Whereas topological concepts develop step by step and without a reference system, projective concepts operate with reference to coordinated perspectives and to planes on which figures are projected.

**Euclidean space** involves the conservation of straight lines, angles, curves and distances. The dimensions of Euclidean space move from the concept of the simple straight line to the concept of surface involving the addition of the left-right or above-below to before-behind relation, and finally to the concept of volume which is the simultaneous consideration of the left-right, above-below and before-behind relations.

From a psychological point of view both projective and Euclidean concepts are the outcomes of topological ideas incorporated into a system of viewpoints. Both concepts develop independently from topological concepts, but are interdependent in their evolvement.

**Purpose**

There is little reported research on the development of spatial concepts on the representational level with visually limited children. The purpose of this exploratory study is to examine Piaget's theoretical development of spatial cognitive development in the low vision child.

TABLE 2
SPATIAL RELATIONS

**Topological Space**

Deals exclusively with instrinsic relationships without attempting to locate objects in relation to others; no reference point external to the object; perception of object's proximity, order, closure; homeomorphism is a basic notion of topological equivalence.

**Projective Space***

Coordination of perspectives and the reversibility of points of view; requires locating objects in relation to each other; child is reference point to before-behind, left-right, above-below, but ignores objective distance.

**Euclidean Space***

Coordinate of different perspectives of an object but also requiring conservation of surfaces, lengths or distance (leading to metric system); concrete operation coordinates the objects among themselves with reference to a total framework.

*Projective and Euclidian Space develop parallel to each other, distinct but closely related and interdependent.

An exploratory type of field study, according to Katz (1962), *seeks what is* rather than *predict relations* to be found. Exploratory studies have three purposes: to discover significant variables in the situation, to discover relations among variables, and to lay groundwork dor later, more systematic and rigorous testing of hypotheses (Kerlinger, 1964). The major purpose of this study is the third one cited by Kerlinger – to lay groundwork for later, more systematic and rigorous testing of generated hypotheses.

The aims were to examine the appropriateness of Piaget's methods and materials for assessing spatial development in low vision children, and to assess if there is any indication of deviation from Piaget's hierarchy of spatial development in low vision students.

**Subjects**

A sample of 10 girls was selected from Daily Living Skills Summer Programs of three L. A. County districts. They were low vision secondary students whose visual acuity ranged from 20/70 to 20/400 – all were large print readers. They were in normal intelligence range, between the ages of 12 and 18, and free of any major auditory or additional physical impairments.

**Instruments**

Five Piagetian tasks were selected which assess how subjects deal with topological, projective and Euclidean space. They were:

| | Task | Simple Description | Space |
|---|---|---|---|
| 1. | **Study of Knots** | Knots (K) | Topological |
| 2. | **Coordination of Perspectives** | Mountains (M) | Projective |
| 3. | **Affinitive Transformation** | Rhombus (R) | Transition to Euclidean |
| 4. | **Localization of Topographical Space** | Village (V) | Shift from Topological to Projective & Euclidean |
| 5. | **Diagrammatic Layout** | Layout (L) | Shift from Topological to Projective & Euclidean |

All tasks except 2 were reproduced according to the description of Piaget and Inhelder (1967). Task 2 followed the adaptation made by Laurendeau and Pinard (1970).

## Results

Because the operations in Task 1-4 are constantly tied to action, they are concrete not formal operations. The reasoning required in these tasks involve the manipulation of concrete operations and are not limited to verbal propositions. Of the ten subjects, nine mastered topological space, but not one mastered all four tasks of projective and Euclidean space at the concrete operation stage. Since concrete operation develops from 7-11 years, it would be expected that all subjects operate on the concrete level for topolotical, projective and Euclidean space. This was not evidenced in this low vision sample of secondary school girls. Table 3 reports the number of subjects who achieved concrete operations on the various tasks.

The significant result of this study is that the visually limited subjects were not able to achieve total decentration of thought, thereby not allowing their spatial concepts to develop independent of perception and action. According to Piaget, subjects at the chronological ages of those in this study should be able to decentrate their thoughts from actions. All should be operating at Substage IIIB, none were in *Coordination of perspectives* (mountains) and *Diagrammatic layout* (layout).

## Discussion

### Topological Space

In the task involving topological space (knots), the subject was to examine the mental analogues of the action of "surrounding" (or intertwining) in terms of the action of following or assembling one element after another. The model is analyzed with the aim of re-establishing the correspondences and rearranging the elements. Although the basis of homeomorphic analysis is the structual equivalence between figures, each figural object is considered in isolation. Perceptual proximities are totally inadequate for this purpose.

Since the separation of the elements is required, both for effecting the mental transfer between the model and copy, and for the preliminary analysis which must precede it. The subject, in order to accomplish this task, must perform certain concrete operations.

Topological space is primitive in that it is purely internal to the particular figure whose intrinsic properties it expresses, and does not involve spatial relationships between two or more figures. The development of topological space prior to that of projective or Euclidean space was substantiated in that nine (9) of the ten (10) subjects mastered the concrete operations required of this task, without concommitant achievement in the tasks involving projective and Euclidean space. The one subject (1) who failed this task and who was still operating on an intuitive level did not achieve mastery on any of the projective or Euclidean tasks.

### Projective Space

The task involving the *Coordination of perspective* (mountains) requires several distinct objects to be coordinated in bi-dimensional projective space (left-right, before-behind) according to several different perspectives and according to the successive positions of an observer different than the subject himself. Egocentric responses to this task include those that exactly reproduce the point of view of the subject or that reproduce the point of view as seen by the subject as he leans toward the toy man to see the same thing as he does. Partial decentration responses would include focus of right-left relations while before-behind relations may be reversed. Total decentration requires the subject to focus simultaneously on projective right-left relations while reversing before-behind relations.

Although the task does not derive from formal level (since the subject is not required to consider two different systems of relations at once) the *Coordination of perspectives* requires a degree of complexity which places it at the last period of the concrete operational stage. Two of the 10 subjects mastered the concrete operations involving bi-dimensional projective space.

In discussion of projective space for these low vision subjects certain comparison require stating. Possibly due to the visual loss, the subjects are less able to handle planes of depth in particular, projection in general. The subjects' ability to conceptualize projective space is the testing focus in *Coordination of perspectives* (mountains) where the mountains are hidden (behind) or in front of others (before) each other in the various pictures. Depth projection is required. The question raised is that when a child is lacking in visual depth perception does this inhibit projective space conceptualization?

*Coordination of perspective* reflected more than the other tasks quality and insufficiency of verbal responses. The low vision subjects appeared to be less verbal, more reticent in their responses than the protocols of Piaget and Inhelder (1967) and Laurendeau and Pinard (1970). The attitude of the less one says, the less one is incorrect may be operating.

### Transition to Projective and Euclidean Space

All the subjects on the rhombus test were able to see that the parallelism of the sides were linked operationally with the transformation of the figure as a whole and were not simply perceived or imagined intuitively. Whereas the responses were characterized by an emergence of concrete operational thought, only three of the ten subjects were able to give explicit formulations of the way in which the relationships function or were able to deduce the whole process in advance.

Tasks 4 and 5 *(Localization of topographical positions* and *Diagrammatic layout)* both dealt with the extension of topological concepts into projective and Euclidean concepts. The subjects were forced to coordinate projective points of view, as well as Euclidean relationships involving distances

and axes. Layout, 5, also includes an element of proportion. The former task needed only concrete operational thought for completion whereas the *Diagrammatic layout* requiring more than one comprehensive system of relations which relied on formal abstract operations for mastery. Five subjects attained the concrete operational stage of thought in Task 4; none reached concrete or formal operations required for mastery in Task 5.

*Diagrammatic layout* required projection by selection of one point of view; a system of coordinates using straight lines, parallels and angles; and scale reduction (similarity and proportion). Hence the construction embodied elements previously tested. Not one subject mastered all four tasks of projected and Euclidean space. The four subjects who attained Substage IIIA in *Diagrammatic Layout* were still operating at Substage IIA (2 S's) and Substage IIB (2 S's) in *Coordination of perspectives.* This again indicates the need for further investigation projective space at the representational level.

Two major hypotheses come from this study: (1) visually limited subjects while showing mastery of topological space are deficient in their understanding of projective and Euclidean spatial relationship; and (2) visually limited subjects show levels of thought that oscillated between intuitive ideas and the emergence of concrete operational thinking. Chronologically, subjects can be expected to have mastered all the spatial relationships on the concrete operational level.

**Implications**

Since spatial concepts are internalized actions and not merely mental images of external objects or events; it does seem essential, especially for the education of visually limited children, that more emphasis should be upon the sequential growth and development of spatial concepts. Depending upon the child's cognitive developmental level of topological, projective and Euclidean space concepts, an educational setting can offer structured programming utilizing spatial relationships. The child by means of adequate and varied experiences can be expected to progress sequentially from perceptual and preoperational to concrete and formal operations.

Studies have indicated that didactic instruction can facilitate the transition from one stage to another. Verbal didactic instruction can include such procedures as prior verbalization of principles, use of berbal rules and confronting the child with his contradictions.

Although there is increasing educational concern with spatial concepts, the developmental nature of these has not been a source of concern. Curriculum deals almost entirely with topological space or positional aspects of space, seldom including coordination of perspectives on a two-dimen sional or three-dimensional basis. "To arrange objects mentally is not merely to imagine a series of things already set in order, nor even to imagine the action of arranging them (Piaget and Inhelder, 1967, p. 454)." This statement has far reaching implications for Orientation and Mobility school personnel and teachers of the visually handicapped concerned with educational aspects of orientation and spatial awareness.

Spatial concepts are actions internalized in a series of states. At each stage the child's mental operations are transformed. There is an active transformation beginning with muscular adaptation, to imitation and delayed imitation at the conceptual or imaginal level.

A spatial field is a single schema. "Every effective assimilation has as its counterpoint a more or less effective accommodation (Piaget and Inhelder, 1967, p. 455)." Therefore the spatial conceptual levels of children are constantly adapting, but dependent upon the quality and variety of experiences actively encountered. Piaget's theory adds important dimensions to problems concerning orientation of visually limited students – projections of fields, rotation of planes, coordination of perspectives.

Because the low-vision subjects included in this study continually oscillated between egocentric and decentration of thought, it does appear indicative of some characteristic learning behavior. If children with low vision, those effectively utilizing their residual vision, are persistently performing with partial decentration, there may be a need for additional experiences at the preoperational and concrete levels in order to compensate for the strongest inclinations or bonds to the perceptual level. These low-vision students as a group were functioning at high levels of visual efficiency. Does this affect their ability to achieve total decentralization required for concrete and formal operations? Or, will they remain longer at partial decentration? And do they require more experiences with projective space?

The next implication is quite relevant to the study of geometry. Concrete and formal operations are necessary for application of geometric principles. Many visually limited children are extremely deficient in mathematical and geometric concepts. Many of the subjects were not operating at the concrete level of projective and/or transitional to projective and Euclidean space. Piagetian tasks do appear to offer greater insight into the mental operations of visually limited children in respect to spatial orientation, mathematical and geometrical concepts. The practice of offering high school geometry to a visually limited secondary student who is not functioning at the concrete level appears extremely questionable. The student would require for success in geometry at least transitional conceptual abilities and the ability to project.

In conclusion, operational space encompasses much more than the concerns of today's curriculum – positional concepts, body image, position location plus coordination of more than one perspective without concrete empirical props. Opportunities to develop mental operations using

similarity and proportion are also indicated. The conceptual development of children up to representational space (formal operations) includes a wide array of spatial relationships – topological, projective and Euclidean. These concepts begin development below two years of age.

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## Application of Piagetian Theory ot Exceptional Children

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The developmental psychology of Piaget has been interpreted by various writers in terms of assessment, educational guidance, early intervention, and curriculum development, among others. Applications of Piagetian theories to the study and education of exceptional children are currently being investigated. Interest in the relevance of these developmentally oriented theories of children's cognitive and linguistic development to exceptional children led to the present research on the effects of verbal language deficit associated with hearing impairment on children's representation of space.

According to Piaget and Inhelder (1956) representational space differs from perceptual space in that it is an intellectual operation involving the reconstruction and internalization, at the symbolic level, of sensory motor space. They suggested that this stage of spatial development occurs between 2:0 and 11:0 years of age. Preoperational spatial representation, occurring about 2:0 to 7:0 years of age (Piaget & Inhelder, 1956) remains subordinated to spatial configurations and to the necessity for proximity to the objects or events being represented. As the child develops a more efficient system of representation he becomes less subordinated to the need for proximity. This gradual move from concreteness leads to an operational level of spatial representation (Piaget & Inhelder, 1969).

Basic to the hypotheses of the present study are the theories concerning the role of verbal language in intellectual operations. Piaget (1952, 1959, 1962) attributed a subsidiary role to language in early cognitive development. On the other hand, the Language School, represented by Bruner (1966), Luria (1967), Vygotskii (1962), and Olson (1970), among others, held that language directs, elaborates and organizes cognitive processes.

Thirty-two subjects with profound, prelingual hearing impairment (HI) and 32 subjects with normal hearing (H), performed on two tasks of spatial representation. The *S*s were matched on age, sex, intelligence score, and socioeconomic level, and were divided into two age levels; 3:4 to 5:11 and 6:0 to 8:1 years of age. All subjects were judged to be average learners for their age level and were free of any obvious learning handicaps, aside from the auditory deficit noted for the hearing impaired group. The dependent measures, taken from adaptations by Laurendeau and Pinard (1970) of those used by Piaget and Inhelder (1956) were essentially nonverbal in nature, and included the stereognostic (haptic) recognition of objects and shapes, and the localization of topographical positions on model landscapes. The tasks involved a transfer from either haptic to visual, or visual to visual data. Each test was composed of two sections: the *A* section was largely a test of topological spatial relations of openness, closure, proximity, etc. Section *B* involved more advanced euclidean and projective spatial relations such as measure and distance, in addition to the topological relations. In section *B* of the stereognostic test, the beginnings of euclidian relations were involved, but the task could be at least partially solved at the preoperational level of representational space. The more difficult sections of the location of topographical positions on the model landscapes required a higher level of spatial representation, reaching the operational level on the 180° reversal positions (Laurendeau and Pinard, 1970).

Spatial performance scores were analyzed in terms of the hypotheses of the study as follows: (1) the effects of verbal language deficit on overall spatial ability; (2) the effect with increasing age of early verbal language deficit on higher level spatial performance; (3) the effects of verbal language deficit on the sequence of children's spatial development.

On the stereognostic test, no significant differences were found between the H and HI groups. However, there was an apparent trend for the HI to be superior to the H. This might be an indication that the HI were more thorough in stereognostic (haptic) exploration because they were forced to rely on other than auditory cues for learning the spatial dimensions of objects in their environment. Considerable emphasis is generally placed on tactile experience in the education of young HI children. However, such training may not be the main variable here since the 3:4 to 4:0 years HI subjects who had less than six months educational experience were better than the young H subjects of the same age. Another possible explanation for the apparent trend toward superiority of the HI over the H on this test, is that the H might have been distracted from efficient haptic exploration by their efforts to attach verbal labels to the shapes. In fact, nearly all H subjects attempted to label each object as they touched it. Though not significant, the difference between the H and HI groups, in favor of the HI, was greater on the more abstract shapes in the *B* section of the test. The labels for the more abstract *B* shapes, such as rhombus, trapezoid, ellipse, might not have been within the vocabulary of even the older H subjects. The HI subjects, who apparently had few or none of the verbal labels relevant to the task, were perhaps less affected by a verbal interference factor.

On the localization of topographical positions on the model landscapes, the old H subjects were significantly better than the old HI subjects on the most difficult task, the 180° reversal. The H tended to be better than the HI on all segments of this task. This is in contrast to the apparent superiority of the HI noted on the stereognostic test, and might be explained in terms of a more complex representational level. The localization task involved the replication by the *S* of E's positioning of his man on the landscape

board. This task was performed in the presence of several sources of perceptual distortion and distraction; e.g., the different sizes and colors of the houses, and railroad tracks, etc. The ability to organize the objects on the landscape in terms of their relationships to one another would be expected to enhance performance. This coordination of relationships would involve euclidian and projective spatial relations and a medium of symbolic representation. The difficulty of the representational task and the degree of perceptual deformation could be reduced through the medium of verbal coordinations. On the other hand, the child who attempted to solve the task by ikonic representation of all or some of the aspects of the landscape, would more likely be subject to perceptual distortion. It is possible, therefore, that the consistent trend of superiority of the H over the HI on this task was due, in part, to their possession and use of more of the relevant verbal labels in terms of the euclidian and projective spatial coordinations involved. This explanation would support Bruner's (1967) and Luria's (1969) directive and regulatory view of berval language in cognitive behavior.

Piaget maintained that language is not a necessary part of preoperational spatial representation. The findings of significant differences between the 6:0 to 8:1 years H and HI, and the lack of significant differences between the 3:4 to 5:11 years H and Hi tend to support Piaget's stand for an increasing role for language in higher level spatial representation. However, the fact that there were consistent trends in superiority for the young HI on the stereognostic test, and for the young H on a topographical tests, would also seem to support a view for a more important role for language at the earlier ages than is ascribed to by Piaget. A differential effect due to verbal language might be postulated, in which the young HI child's assumed ikonic system of spatial representation served him better in the stereognostic task, and the young H child's verbal language superiority served him better in the more complex topographical positions tasks.

The findings relative to the young *Ss* might also be interpreted in terms of the critical period hypothesis of language acquisition (McNeil, 1966; Callaway, 1970). The young H subjects may have been affected by the interaction between the advent of preoperational cognitive structures and the beginnings of language acquisition. This interaction can be compared to Piaget's (1969a) proposed period of reconstruction of sensory motor experience at the symbolic level. He suggested that a lag in spatial performance might be expected during this reconstruction period, in which the child is involved in coordinating perceptual and symbolic processing of information. Piaget (1969a) discussed this lag in performance as follows:

> This initial advance and subsequent loss of ground on the part of perception . . . (the perception of Euclidian good forms at a level when their representation remains topological, etc.), obviously speaks in favour of a general reconstruction on the representational and operational planes rather than of a progressive abstraction of their structures from perception . . . if representational comprehension is more difficult than perception, a new construction is not just an abstraction that must be involved; . . . it is because of this new construction that the initially lagging representation finally overtakes perception (p. 330).

This theory might be used to explain the poorer performance of the young H subjects on the stereognostic test. The verbal language ability of the young H subject, in its beginning stage, was possible a hindrance rather than an asset, because it was not yet coordinated with the perceptual processes. The young HI subject, on the other hand, because of his poorly developed verbal language system may not have been involved in the reconstruction period at this age. On the other hand, whereas the older H subject would be expected to have moved through the reconstruction period into a more efficient representational stage, the old HI might well be delayed in their entry into this reconstruction period due to their lag in verbal language development. Such a delay in the occurrence of the reconstruction period might partially explain their significant inferiority on the higher level tasks and also suggest a greater role for verbal language in early representational processes than is indicated by Piagetian theory.

The third hypothesis of this study which suggested that verbal language deficit would not affect the sequence of children's spatial development was upheld by the findings of this study. Piaget and Inhelder (1956) proposed a sequence in which topological relations precede euclidian and projective spatial relations in the child's spatial development. Both groups were significantly superior on the topological section than they were on the euclidian and projective section of each task, a finding which was in agreement with results reported by Peel (1959), Laurendeau and Pinard (1970), and Thirion (1968). The results of thiz study appear to support Piaget's claim that cognitive structures, be they spatial representation or other, evolve independently of verbal language. However, it appears also feasible that it is the sequence of development, rather than the development of the structure, which is independent of language. The rate and level of spatial development appears to be affected by the level of verbal language. The findings of this study regarding the primacy of topological relations and the significant superiority of the old H subjects over the old HI subjects, appear to support this view.

**Implications for Education and Future Research**

Spatial representation has frequently been considered a process which is largely divorced from verbal language

ability (Smith, 1964). The findings of this study which appear to indicate that verbal language may be a factor in early spatial representation are highly pertinent to early childhood training and curriculum. There appears to be support for a developmentally oriented coordination of verbal language training and spatial experience for all children, but especially for the hearing impaired and other language handicapped children.

The primacy of topological spatial relations has direct implications for early childhood programs of art, handwriting, arithmetic and verbal language training, and for the sequencing of experiences to reflect this primacy.

A broader implication for those who are involved with exceptional children, is the developmental emphasis of Piagetian theories. The developmental nature of physical and motoric aspects of the child's growth have long been a focus in early childhood education. The developmental nature of cognition and language, and the interrelationships of the various processes deserves increased attention.

The findings of this study also indicate that the hearing impaired, and other language deprived children, offer a rich and relatively untapped source for research on the role of verbal language in cognitive development.

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**Review of Recent Research Relating to the Emergence and the Age of Attainment of Volume Conservation During Adolescence**

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In relation to the reviewed research, the following conclusions can be drawn:

1. Formal operation thought is a sequential developmental process occurring in all types of children. All of the research (which included the mentally gifted, the mentally deficient and those of average mental ability) supported Piaget's hierarchical paradigm.

2. Children of all types differ greatly as to age of emergence of formal operations. Piaget's declared normative ages for emergence of formal operations (C.A. 11-14) do not correlate well with the age of emergence for large percentages of children involved in the research. For example, Verizzo (1970) finds that many gifted children (I.Q. above 130) who were 13 to 14 years of age were unable to solve volume conservation problems while many of the younger children (8 years of age) were exhibiting a good comprehension of volume conservation. In other words, a large proportion of the gifted children were exhibiting formal operations as much as two years ahead of Piaget's normative age scales. On the opposite end of the intelligence continuum, educationally subnormal children (I.Q. range 46 to 80) were found by Lister (1970) to exhibit conservation behaviors at somewhat different ages (though the discrepancy apparently was not as large as those with gifted children). Shainberg (1970), in reviewing clinical records of disturbed adolescent boys (ages around 17) and of adult neurotics, hypothesizes that the subjects exhibited only concrete operations in their daily functioning. He claims that the disturbed boys' over-concern with arranging things (e.g., automotive parts) and involvement with the parts and the way the parts fit into specific wholes is illustrative of concrete operational thought. Moreover, according to Shainberg, the neurotics, in expecting and demanding actuality to conform to their own defined systems also exhibit the concrete operational pattern.

Higgens-Trenck (1971) discover that among "normal" children (further identification such as I.Q., school performance, etc., was not denoted), over fifty percent of the 17 year old adolescents were non-conservers on Piaget's volume tasks (i.e., had not attained formal operation thought), and in reviewing performance on verbal situational tasks, the authors concluded that relatively few of the adolescents seemed capable of using or inclined to utilize formal operations with any type of task. Like Piaget, Karplus and Peterson (1970) assume that the ability to utilize the ratio or proportion in abstract thinking is one of the discriminating factors that differentiate formal operations from concrete operations. The researchers find that proportional reasoning is not achieved by most students until the last years in high school (chronological ages around 17 to 18).

Thus, in summary, it appears that intellectual ability (as defined by the Stanford-Binet and Wechsler intelligence scales) may have more correlation with age of attainment than chronological age. It does seem from the research that gifted children will tend to exhibit formal operations before other children, and educationally subnormal children will tend to exhibit the behaviors after other children have attained the operations.

3. However, given children within the average range of intellectual ability, the problem is determining those factors which encourage or prohibit the emergence of formal operations. The reviewed research suggests that variables which appear to influence the emergence of formal operational thought may include (1) emotional or psychological stability. Shainberg, as previously cited, notes the absence of formal operations in the daily existence of disturbed adolescent boys and adult neurotics. He does not, however, approach the question of whether or not these subjects previously had attained formal operational thought and the disturbance caused a regression – a resortion to the previously used and previously successful modes of concrete operations. However, Higgens-Trenck, in explaining the failure of "normal" adolescents to exhibit formal operations, hypothesize that the egocentrism of the adolescents prevent them from approaching problems or tasks in an objective manner; that new problems or tasks encourage the adolescent to use the more familiar concrete operational modes of thinking, even though the ability to use formal operations is present.

The second variable that the reviewed research designates as a possible influence on the emergence of formal operations is verbal ability. Verrizzo (1970) asserts (but does not prove) that conservation of volume may be attained earlier if children comprehend the distinctions between the words "mass," "weight" and "volume." Her hypothesis may simply be redundant, for according to Piaget, words will not be truly meaningful (cannot be generalized to other situations) unless the structures are already intuited.

Bart (1971) hypothesizes that at the start of formal operations, the connection between language and cognition may be closest, as the capacity to generate theories and state various hypotheses and explanations relates not only to formal operations but requires language skills.

Third, the reviewed research notes that the content of the evaluating task may influence the emergence of formal operations. Higgens-Trenck (1971) find that fewer adolescents utilize formal operations in a written situational

problem than on the Piagetian task. Bart, (1971) utilizing Guilford's content paradigm, claims that the content in which the task is presented may be an important variable in eliciting or permitting acquisition of formal operations in that individuals capable of applying the operations to tasks in one content area are more apt to apply the skills to other tasks within the same content area rather than to tasks in different content area.

In analyzing the influence of content, Brainard (1970) stresses that the similarity of the Piagetian tasks utilized to measure a specific operation (i.e., volume conservation) is more apparent than real. He implies that no one task can be utilized to evaluate the attainment of any one operation let alone the attainment of formal operations.

The fourth variable, which the reviewed research indicates may be a possible influence on the emergence of formal operational thought, is teaching methods. Karplus (1970) finds that suburban students were achieving a substantial mastery of the ratio task by the end of high school, while the urban student showed relatively slight progress. The researchers emphasize that the difference in performance between urban (inner city) and suburban children was insignificant at the sixth grade level, (approximately when formal operations should be emerging according to the Piaget paradigm) but was substantial in the high school grade levels. The researchers note that the attainment or lack of attainment may be due to teaching methods and teachers, because substantial differences were found between classes within schools as well as between the demographic areas. Lister (1970) indirectly emphasizes the importance of teaching methods in her efforts to teach educationally subnormal children to conserve volume. She reverses Piaget's theory of sequence of substance, weight and volume conservation by teaching her non-conserving children the more difficult volume concept first. Later she insinuates that the teaching time of operations could be shortened by attacking the most difficult concept first. Brainerd stresses that the teaching of operations must follow very specific procedures that promote a particular operation within an operation. He stresses that for transfer of learning from a conservation task to occur, the similarity between the class of conservation learned and the class of conservation to which transfer is guided must be very close. Howe and Butts (1970) disregard the importance of teaching variables in promoting the emergence of formal operations. (They do not approach the question of teaching methods hindering the emergence.) They stress the importance of instruction waiting for the emergence of intellectual operations since tuition before readiness is fruitless.

The following implications for psychotherapeutic strategies in relation to adolescents can be derived from the reviewed research:

1. Some teenagers who have achieved formal operational thought will be able to profit greatly from a verbal, intra-personal therapeutic experience.
2. High therapeutic drop-out rates among adolescents may be due to therapies requiring the utilization of formal operations (requiring the individual to think about problems beyond the current concrete environment, to imagine the many possibilities inherent in the hypothesized situation, to isolate all the variables in the possibilities and to successfully eliminate the non-relevant variables). According to recent research, most adolescents have not developed or do not utilize these operations.
3. Since many adolescents still utilize concrete operations, optimal therapeutic experiences should begin with the adolescent present in the situation or environment where the teen-ager is experiencing the difficulty. Therefore, the therapy might involve family groups if the problem occurs at home, for example, or behavioral modification techniques either in the home or in the school room.
4. Therapies which must be conducted away from the conflict situation might utilize psychodrama or focus upon the existing relationships between the therapist and patient or between patients if group therapy is utilized.

For the diagnosis of learning problems:

1. The utilization of Piagetian tasks appears to be evaluating learning behaviors which the more standardly utilized intelligence tests do not.
2. Piagetian tasks appear to measure conceptual learning behaviors which may be a prerequisite for mastery of subjects such as mathematics and science.
3. Unfortunately, no specific prognostic test of formal operations which is brief and easily transportable has been devised. There is also a great question as to the validity of a single task measurement approach.
4. If a Piagetian task is utilized for assessing attainment of formal operations, the student's preferences in relation to content, current emotional state, and verbal ability must be taken into account.

In relation to the consulting process with teachers, the following implications can be derived from the reviewed research:

1. As there is some doubt as to attainment of formal operations even by adults (particularly when confronting new materials or an anxiety stimulus – such as the psychologist) all intervention methods which require the teacher's physical participation should be utilized. An example would be behavioral modification techniques which the teacher practices in the psychologist's presence.
2. The teacher should be informed that a large majority

of adolescents will need to participate physically with learning materials in the learning process before attempting to work with hypotheses and explanations.

3. Prolonged and varied practice (that is in terms of differing content) with currently acquired intellectual operations should be provided in order to promote the maximum transfer to other formal operations.
4. The teacher might be encouraged to evaluate those students who are experiencing learning difficulties, (not utilizing formal operations) through the administration of Piagetian tasks.
5. In encouraging the elicitation of a new formal operation, the new task should be (1) presented in content which suits the individual's learning style. (2) The new task should not differ greatly from the previous operations learned.
6. For remedial F.O.T. purposes, work might be given in ratio or proportion reasoning or in language utilization (such as the elaborated sentences as depicted in Bernstein's model).
7. The teacher should be aware that some adolescents will benefit primarily from practicing abstractions via hypothesis making.

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# A Cross-Cultural Investigation of Conservation

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The growing literature of cross-cultural studies of Piagetian tasks reflects primarily an interest in testing the universality of Piaget's stages of cognitive development. Dasen & Seagrim's (1969, 1970, 1971) inventory of such cross-cultural research is perhaps the best demonstration of this expanding concern. Le Vine (1970, p. 581) suggests that, by testing various populations, those critical of Piaget's theory attempt to refute his stage formulations, whereas Piaget's supporters seek to demonstrate their universality. On the whole, children in non-industrial societies have been found not only to score low on traditional Western intelligence tests, but also to demonstrate a slower or even curtailed rate of development on Piagetian tasks (Bruner, et al., 1966; Le Vine, 1970). Usually these differences are attributed to environmental variables, such as lack of formal schooling, residence in rural areas, and/or "linguistic handicaps" (Le Vine, 1970; Vernon, 1965). Greenfield (1966) for example, found that schooled Wolof (Senegalese) children differed more on conservation tests from unschooled Wolof children than they did from European children. Several studies have found that European children do better on Piagetian tasks than Australian Aboriginies (e.g., Dasen, 1970; De Lacey, 1970; 1971; De Lemos, 1969; and Nurcombo, 1970), but again environmental differences (for example, frequency of contact with Euroepans) played a significant role. The same was true in studies of Piagetian tasks by Hyde (1970) involving Arab, Indian, Somali, and European children and Lloyd (1971) with Yoruba children. Cole & Bruner (1971) and Cole, et al. (1971) have emphasized the importance of the situation, that is, its significance "for the person's ability to cope with life in his own milieu (Cole & Bruner, 1971, p. 874)." Only a few cross-cultural studies (e.g., Price-Williams, Gordon & Ramirez, 1969) have tried to evaluate the significance of Piagetian tasks with respect to the particular milieu of a given sample.

In a summary of cross-cultural Piagetian research Dasen (in press?) has classified these studies as "descriptive" (essentially attempts to verify Piaget's stages in non-Western cultures) and "quasi-experimental" (attempts to link cognitive performance to specific cultural factors). He concluded that (a) in most cases the *sequence* of cognitive development (or the qualitative aspects) proposed by Piaget was confirmed, while the rate and ultimate level reached (or the quantitative aspects) are affected by cultural factors, and (b) the quasi-experimental research has not yet advanced enough to offer solid conclusions regarding specific links between cognitive behaviors and cultural factors.

A number of the cross-cultural studies already referred to have based their conclusions on conservation tests. Others following this approach include studies of Canadian Indians, Eskimos and whites (Vernon, 1966); Zambian (Heron & Simonsson, 1969), and Lebanese (Za'rour, 1971a; b) children. Finally, Furby (1971) has provided a theoretical framework for interpreting cross-cultural studies of conservation by distinguishing between manual and automated environments, on the one hand, and empirical and magical types of reasoning, on the other.

Unfortunately, much of the cross-cultural research suffers from methodological problems, some of which have been printed out by Le Vine (1970). They include frequent reliance on one task, whose reliability may not have been demonstrated, relatively small samples, prevalence of two-group comparisons, and predominant use of one-age group. The present study represents an attempt to overcome some of these difficulties. The purpose of this research, then, is two-fold: (1) To assess the sequence and rate of conservation acquisition in several different cultures, using six different tasks as measured by a reliable instrument and administered to sizeable samples of boys and girls in five different age groups, and (2) To assess the cross-cultural reliability of the Concept Assessment Kit-Conservation.

## METHOD

### Measure of Conservation

Conservation was assessed by the standardized procedures of the Concept Assessment Kit-Conservation (Goldschmid & Bentler, 1969a). Prior and subsequent studies (Goldschmid, 1967, 1968a & b, 1971; Goldschmid & Bentler, 1968b; Bentler, 1970, 1971) have demonstrated the Kit's test-retest reliability, internal consistency, homogeneity and validity when used with American children. The Kit, normed for children between 4 and 8 years of age, includes 3 scales. Scales A and B are parallel forms and are composed of the following 6 conservation tasks: Two-dimensional space, number, substance, continuous and discontinuous quantity, and weight. Scale C measures a slightly different dimension of conservation and includes area and length. Scale A was used for all samples in this study.

Briefly, the procedures, which are standardized and identical for each subject, in administering the Kit are as follows. The children are asked to compare the relative quantity, weight, etc., of two objects after the shape or form of one of them has been transformed by some manipulation. Before each transofrmation, the examiner makes sure that the subject perceives the two objects as initially equivalent. In addition to his judgment of conservation, the subject is asked for an explanation of his response. Thus, the possible maximum score is 12, 1 point for each correct judgment and each correct explanation on the 6 conservation tasks.

**Subjects**

An attempt was made to obtain, for each country included in this study, conservation scores on a minimum of 250 subjects – 25 boys and 25 girls from each of 5 age groups from 4 to 8 years. In most instances the samples available approximate or exceed these figures. A breakdown of the actual numbers of subjects can be found in the first line of Table 1 for males and Table 2 for females.

Except for Uganda, the children were primarily from an urban and middle-class background. Most children in the sample had not received formal schooling before the age of 6 except for New Zealand and Poland.

In many respects the Uganda sample is not comparable to the others. The subjects came to a large extent from a rural area. Furthermore, no reliable data could be obtained on their socio-economic status, nor, in some cases, on their age. Finally, their schooling is not comparable to those of the other subjects.

**Procedure**

Form A of the Concept Assessment Kit-Conservation was administered in its original version in English-speaking countries or in the native language of a particular sample. In the latter case the test was translated by or under the supervision of the author in question. Except for Uganda, where some exact equivalent terms were lacking, the translation presented no undue problems and was as verbatim as possible.

The authors administered the tests themselves or trained assistants for this purpose. Special note should be taken of the fact that in Uganda the children appeared shy and inhibited in the test situation. This may have affected performance in some cases, particularly the explanation of the conservation behavior.

The subjects' responses were translated into English, where necessary, and scored uniformly by the first author.

**Analysis**

There were two aspects to the data analysis. The first dealt with establishing the measurement qualities of the conservation scores in the various countries; the second dealt with the cross-cultural investigation of changes in score with increasing age. Since it was possible for sex differences to be manifest – although none were consistently found in the United States standardization sample – all analyses were performed separately by sex of the subjects.

If the data collected in various cultures are to be meaningful, it must be demonstrated that the conservation score obtained by the Concept Assessment Kit conservation score is reliable in all cultures. It is known that the scores possess escellent reliabilities in the United States, but whether the test can be used with assurance in other countries has not previously been determined. This can be done by investigating the internal consistency of the observed scores at each age level in each culture. In addition, since the conservation score is composed of two parts representing conservation behavior and the explanation for the behavior, it should be demonstrated what behavior and explanation scores correlate highly in each of the cultures.

## RESULTS AND DISCUSSION

Data summarizing the results obtained with the conservation scores are presented in Table 1 for males and in Table 2 for females. Each table is divided into six sections, representing the six countries in the study. The number of subjects, mean score obtained, standard deviation of the scores, K-R 20 coefficient of internal consistency, and the correlation between behavior and explanation parts of the test are reported separately at each age for which data were obtained in that country.

The K-R 20 coefficients were computed for all samples in spite of the typically small sample size, in comparison to the generally recommended minimum of 100 subjects. Consequently there is much variability in the size of the K-R 20 coefficients. Nonetheless it can be seen that, on the average, the internal consistency of the conservation score was quite acdeptable in all countries. A given country yielded 8-10 samples of male and female subjects, as reported in Tables 1 and 2. For each country the median K-R 20 was calculated across these samples. The median K-R 20s were as follows: Australia, .90; Great Britain, .87; Holland, .86; New Zealand, .90; Poland, .86; and Uganda, .85. These values are sufficiently high to affirm that the conservation score tends to be a reliable measure at each age and sex level in each country. An alternate way of looking at these data is to examine the median K-R 20 values at each age level, across both sexes for all countries. The median values are: Age 4, .68; age 5, .91; age 6, .89; age 7, .87; and age 8, .81. Thus, the internal consistencies are acceptable at all ages, though the age 4 median K-R 20 is quite a bit below the others in value. However, since the data of interest to this study are group differences, rather than individual differences, the value of .68 should be acceptable for such comparisons. It will be remembered that group averages are always more reliable than the individual scores upon which the averages are based.

The correlation between behavior and explanation scores are reported in the last line of each country's data in Tables 1 and 2. The median correlation for each country is: Australia, .79; Great Britain, .68; Holland, .55; New Zealand, .69; Poland, .84; and Uganda, .79. Thus, on the average, the correlations are quite high in all the countries. The correlations for given subjects' ages, across all countries, are: Age 4, .77; age 5, .77; age 6, .79; age 7, .65, and age 8, .48. It is clear that the behavior and explanation parts of the conservation score correlate sufficiently highly to support the judgment that the two parts are measuring the same construct.

TABLE 1
DATA FROM CONSERVATION KIT, TOTAL SCORES, FORM A,
FOR SEVEN COUNTRIES

MALES

| Country | Statistic | Age in Years | | | | |
|---|---|---|---|---|---|---|
| | | 4 | 5 | 6 | 7 | 8 |
| Australian | N | 20 | 40 | 41 | 40 | 1 |
| | Mean | 0.15 | 1.83 | 4.68 | 6.73 | 8.00 |
| | S.D. | 0.48 | 2.76 | 4.59 | 4.18 | -- |
| | KR-20 | 0.41 | 0.88 | 0.95 | 0.92 | -- |
| | *$r_{12}$ | 0.69 | 0.80 | 0.89 | 0.75 | -- |
| Great Britain | N | | 26 | 29 | 25 | 26 |
| | Mean | | 1.77 | 5.69 | 8.56 | 8.89 |
| | S.D. | | 3.15 | 4.01 | 2.68 | 2.87 |
| | KR-20 | | 0.93 | 0.90 | 0.80 | 0.85 |
| | $r_{12}$ | | 0.87 | 0.84 | 0.59 | 0.46 |
| Holland | N | 20 | 22 | 27 | 19 | 19 |
| | Mean | 0.50 | 2.73 | 4.89 | 7.32 | 8.90 |
| | S.D. | 0.74 | 3.48 | 3.64 | 3.57 | 2.57 |
| | KR-20 | 0.20 | 0.92 | 0.89 | 0.88 | 0.78 |
| | $r_{12}$ | 0.34 | 0.75 | 0.68 | 0.51 | 0.31 |
| New Zealand | N | 25 | 25 | 25 | 24 | 25 |
| | Mean | 0.28 | 3.20 | 6.84 | 7.75 | 9.16 |
| | S.D. | 0.60 | 3.85 | 4.06 | 2.96 | 2.72 |
| | KR-20 | 0.28 | 0.93 | 0.91 | 0.80 | 0.84 |
| | $r_{12}$ | 0.59 | 0.80 | 0.87 | 0.52 | 0.41 |
| Poland | N | 26 | 26 | 25 | 25 | 25 |
| | Mean | 0.46 | 5.23 | 7.08 | 7.04 | 8.44 |
| | S.D. | 1.12 | 4.69 | 3.84 | 3.69 | 3.01 |
| | KR-20 | 0.72 | 0.95 | 0.89 | 0.89 | 0.84 |
| | $r_{12}$ | 0.87 | 0.92 | 0.83 | 0.86 | 0.71 |
| Uganda | N | | 27 | 23 | 18 | 31 |
| | Mean | | 3.07 | 3.61 | 4.11 | 6.32 |
| | S.D. | | 2.85 | 3.24 | 2.85 | 4.01 |
| | KR-20 | | 0.81 | 0.85 | 0.79 | 0.91 |
| | $r_{12}$ | | 0.72 | 0.75 | 0.84 | 0.89 |

TABLE II
DATA FROM CONSERVATION KIT, TOTAL SCORES, FORM A,
FOR SEVEN COUNTRIES

FEMALES

| Country | Statistic | Age in Years | | | | |
|---|---|---|---|---|---|---|
| | | 4 | 5 | 6 | 7 | 8 |
| Australia | N | 21 | 40 | 36 | 43 | |
| | Mean | 0.33 | 2.08 | 4.39 | 7.42 | |
| | S.D. | 1.29 | 3.04 | 4.38 | 3.77 | |
| | KR-20 | 0.88 | 0.90 | 0.94 | 0.90 | |
| | *$r_{12}$ | 0.95 | 0.78 | 0.90 | 0.71 | |
| Great Britian | N | | 23 | 21 | 25 | 24 |
| | Mean | | 2.30 | 4.76 | 7.48 | 8.00 |
| | S.D. | | 3.51 | 4.60 | 3.05 | 2.43 |
| | KR-20 | | 0.93 | 0.95 | 0.83 | 0.71 |
| | $r_{12}$ | | 0.77 | 0.94 | 0.43 | 0.49 |
| Holland | N | 20 | 24 | 19 | 22 | 24 |
| | Mean | 0.80 | 1.46 | 4.05 | 6.95 | 9.38 |
| | S.D. | 1.40 | 2.80 | 3.33 | 3.51 | 1.58 |
| | KR-20 | 0.70 | 0.92 | 0.86 | 0.87 | 0.47 |
| | $r_{12}$ | 0.46 | 0.70 | 0.62 | 0.59 | 0.13 |
| New Zealand | N | 25 | 26 | 25 | 25 | 25 |
| | Mean | 0.84 | 4.04 | 6.84 | 7.40 | 9.64 |
| | S.D. | 2.22 | 3.79 | 3.92 | 4.02 | 2.10 |
| | KR-20 | 0.92 | 0.91 | 0.90 | 0.91 | 0.69 |
| | $r_{12}$ | 0.86 | 0.67 | 0.71 | 0.75 | 0.35 |
| Poland | N | 25 | 27 | 25 | 24 | 25 |
| | Mean | 1.12 | 4.96 | 7.44 | 7.21 | 8.16 |
| | S.D. | 1.56 | 3.76 | 3.55 | 2.74 | 2.20 |
| | KR-20 | 0.67 | 0.88 | 0.88 | 0.77 | 0.72 |
| | $r_{12}$ | 0.92 | 0.87 | 0.65 | 0.46 | 0.49 |
| Uganda | N | | 23 | 29 | 20 | 27 |
| | Mean | | 2.30 | 2.28 | 5.70 | 6.59 |
| | S.D. | | 2.12 | 2.74 | 3.95 | 4.39 |
| | KR-20 | | 0.71 | 0.85 | 0.91 | 0.93 |
| | $r_{12}$ | | 0.39 | 0.71 | 0.95 | 0.86 |

* Correlation of behavior and explanation items

TABLE III
CONSERVATION KIT, TOTAL SCORES, FORM A,
AGES 5 TO 8 COMBINED

MALES, FEMALES, AND MALES AND FEMALES COMBINED

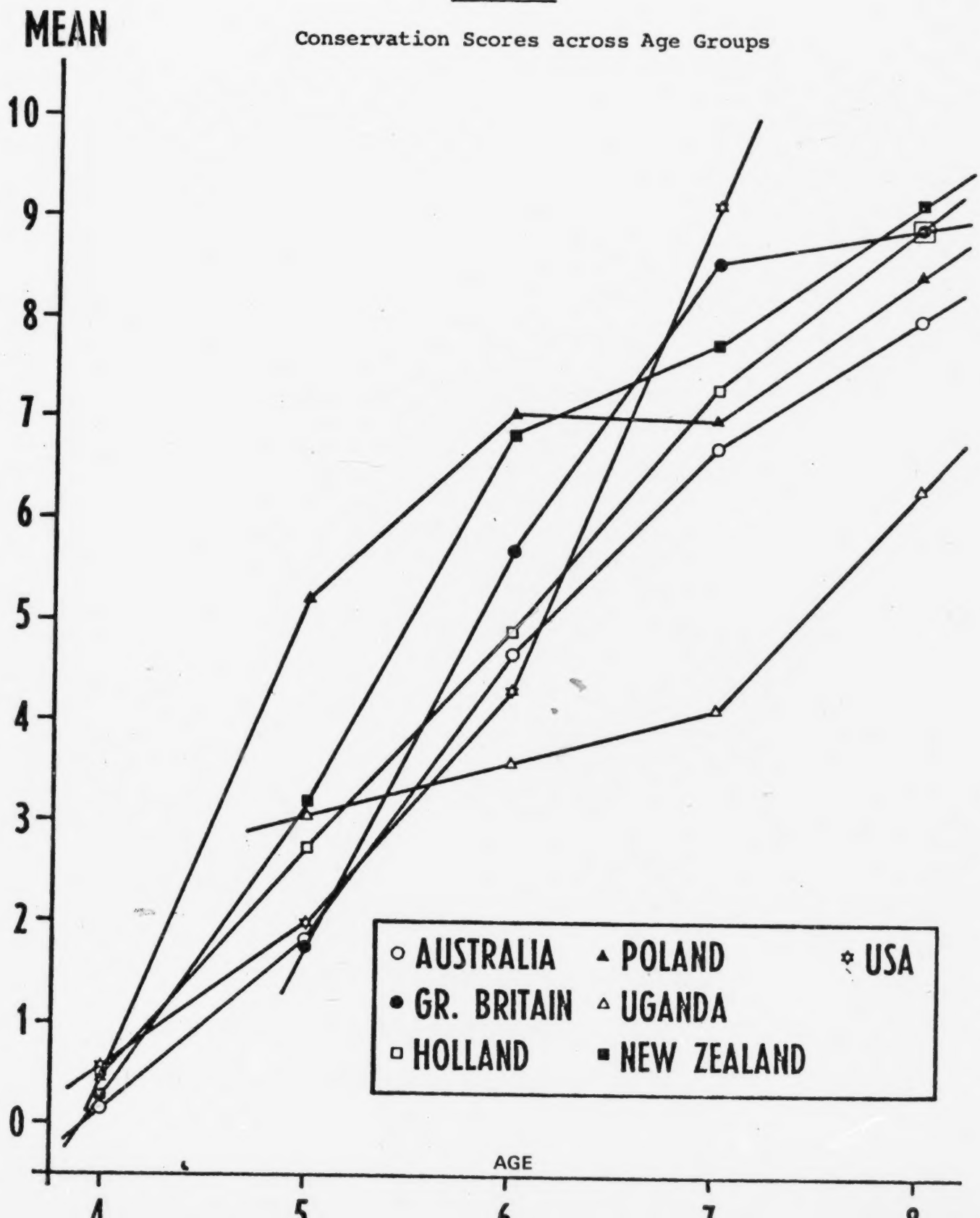
| Country | Statistic | Males | Females | Males and Females Combined |
|---|---|---|---|---|
| Australia | N | 121 | 119 | 240 |
| | Mean | 4.41 | 4.71 | 4.57 |
| | S.D. | 4.41 | 4.37 | 4.40 |
| | KR-20 | 0.94 | 0.93 | 0.94 |
| | *$r_{12}$ | 0.84 | 0.84 | 0.84 |
| Great Britain | N | 80 | 69 | 149 |
| | Mean | 5.31 | 4.93 | 5.13 |
| | S.D. | 4.33 | 4.31 | 4.32 |
| | KR-20 | 0.93 | 0.93 | 0.93 |
| | $r_{12}$ | 0.84 | 0.75 | 0.80 |
| Holland | N | 68 | 65 | 133 |
| | Mean | 4.87 | 4.08 | 4.48 |
| | S.D. | 3.99 | 3.96 | 3.99 |
| | KR-20 | 0.92 | 0.92 | 0.92 |
| | $r_{12}$ | 0.70 | 0.72 | 0.71 |
| New Zealand | N | 74 | 76 | 150 |
| | Mean | 5.91 | 6.07 | 5.99 |
| | S.D. | 4.16 | 4.18 | 4.17 |
| | KR-20 | 0.91 | 0.92 | 0.91 |
| | $r_{12}$ | 0.80 | 0.73 | 0.76 |
| Poland | N | 76 | 76 | 152 |
| | Mean | 6.43 | 6.49 | 6.46 |
| | S.D. | 4.19 | 3.58 | 3.90 |
| | KR-20 | 0.92 | 0.86 | 0.89 |
| | $r_{12}$ | 0.86 | 0.66 | 0.77 |
| Uganda | N | 68 | 72 | 140 |
| | Mean | 3.53 | 3.24 | 3.38 |
| | S.D. | 3.02 | 3.34 | 3.19 |
| | KR-20 | 0.82 | 0.88 | 0.85 |
| | $r_{12}$ | 0.73 | 0.75 | 0.74 |

* Correlation of behavior and explanation items

# MALES

Figure 1

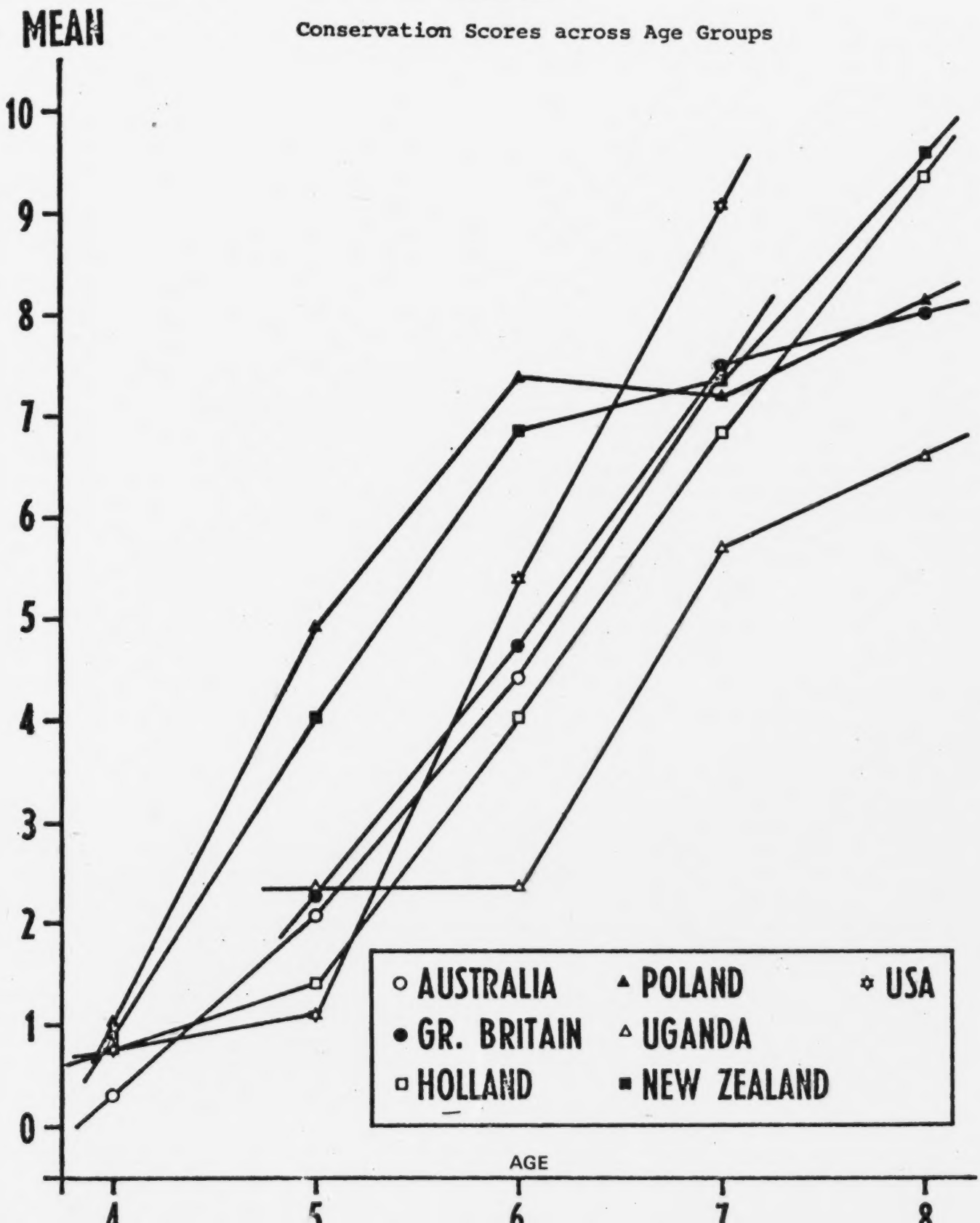
Conservation Scores across Age Groups



# FEMALES

Figure 2

Conservation Scores across Age Groups



The Means of each age group for the six countries are presented in the second line of Tables 1 and 2. These values are graphically presented in Figures 1 and 2 respectively, together with the available U.S. norms from the manual (Goldschmid & Bentler, 1968 a). The general correspondence in age trends for the seven countries is rather remarkable. Except for Uganda, no particularly significant overall differences emerged among the countries or between boys and girls. Probably due to early schooling, the five and six-year olds in the Polish and New Zealand samples tended to score higher than the children of the same age in the other countries. The older girls and particularly boys in the Uganda sample obtained lower scores than the other children. As has been noted before, in some respects, the characteristics of the Uganda sample was not comparable to the others, nor was their test behavior. These differences may largely or even completely account for their lower scores, but additional data will be required to clarify this discrepancy.

To conclude, the Concept Assessment Kit seems to be a reliable indicator of conservation across several cultural groups. In line with previous research (Dasen, in press), the age trends in both males and females suggest that the *sequence* of conservation acquisition is fairly consistent from culture to culture. The *rate* of development appears somewhat less uniform. The variations observed are most likely attributable to specific environmental factors (e.g., schooling) and conform to previous findings (Le Vine, 1970).

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# Conservation, Visual Perception, Self-Concept, and Academic Skills in Kindergarten Through Second Grade Children[1]

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Many studies have been done based on Piagetian ideas about children and their ability to demonstrate their understanding of the concept of conservation. Work has been done concerning normative ages at which children generally acquire the ability to conserve, as they reach a new and higher level of conceptual development (i.e., Elkind, 1961), and much research has been performed in an attempt to systematically increase the speed of acquisition of conservation (i.e., Gelman, 1970; Wallach and Sprott, 1964; and Strauss and Langer, 1970). There has been little research on the relationship of conservation and areas related to children's performance in the elementary school years. The purpose of this study is to investigate *conservation* and whether or not it is related to four areas which are basic to children's experience in the early grades of elementary school. The areas considered will be *visual perception, self-concept, reading,* and *arithmetic.*

There has been little research in this country concerning the relationship between perceptual and conceptual development. According to Piaget (Wohlwill, 1962), perceptual and conceptual development are concurrent, but independent, following different paths and arriving at different ends. Piaget and Taponier (Baldwin, 1966) presented evidence for this idea when they demonstrated that errors of estimation of the top sides of parallelograms increased from age five to age eight, while errors in conservation of length decreased over the same age range. It has been suggested that perceptual development is continuous and probabilistic, whereas conceptual development is determinate and discrete. It might be expected therefore that there would be little relationship between performance on a task of visual perception and performance on conservation tasks. However, it is felt that due to the conceptual aspects basic to tasks of visual perception, and due to the perceptual aspects (predominantly visual) basic to conservation tasks, some relationship between conservation and visual perception (e.g., figure-ground, form constancy, position in space, and space relations), and requires the ability to deal with abstract concepts. In studies on acquisition of conservation, Gelman (1970) and Strauss and Langer (1970) suggested that perceptual cues are critical in conservation tasks.

Even though there is much concern about children and self-concept, there seem to be few effective measures of self-concept for early elementary school aged children, and subsequently, little attention has been given to any relationship between conservation and self-concept. Generally, programs for assessing self-concept (i.e., Coopersmith, 1967) have been aimed at children of about ten years of age or older. Goldschmid (1968) has found that conservers tended to be more objective in their own self-evaluation, were described more favorably by peers and teachers, and generally were viewed as more "attractive" than non-conservers. It would seem that there might be some relationship between the degree or level of conceptual ability and measure of self-concept. In this study the child's score on the Harris-Goodenough Draw-a-Man (Woman) scales was used as a measure of self-concept. Harris (1963) has suggested the use of children's self-drawings as a means of assessing self-concept, and Carlson (1970) found no significant relationship between Draw-a-Man scores and performance on Piaget tasks involving conservation of weight and mass. It was felt that with a more extensive and standardized method of measuring conservation, some relation with self-concept might be demonstrated.

In the area of academic skills there have been some studies (e.g., Almy, 1966; Goldschmid and Bentler, 1968) which have shown relationships between conservation ability and abilities in reading readiness, arithmetic, art, science, and social studies. In the present study, a positive relationship between conservation and academic skills considered was expected.

## METHOD

**Subjects.** Sixty children, all members of Project Follow Through classes in the Compton Unified School District, were studied. Twenty were from a kindergarten class, 20 were from a first grade class, and 20 were from a second grade class. Of the sample, 26 were males and 34 were females. The children ranged in age from five years to seven years, 11 months. The sample consisted of 53 Black children and seven Mexican-American children; all were from a lower socio-economic background.

**Materials.** Used for measurement were: the *Marianne Frostig Developmental Test of Visual Perception;* the *Goldschmid-Bentler Kit for Concept Assessment-Conservation* (Form A); the *Harris-Goodenough Draw-a-Man* (Woman) scales; the *Cooperative Primary Reading Test,* specific grade levels one and two; and the *Cooperative Primary Arithmetic Test,* grade levels – one and two.

[1]The authors express their appreciation to the teachers and administrators at Marianne Anderson Elementary School, as well as to the staff of Project Follow Through in the Compton School District for their support and cooperation in this study.

**Procedure**. As part of the regular testing program in the school, all first and second grade Ss were given the reading and arithmetic tests which were administered as group tests by the regular classroom teachers. The Frostig test was also given as a group test to each of the three classes. This test was administered by the E with the aid of a proctor and the classroom teacher.

After the group tests were completed, 20 Ss were chosen from each of the three grades. Sampling was based on the availability of Ss who had taken all group tests necessary. Each S was tested individually with the Conservation Kit; then each S was given a sheet of paper and a pencil and asked to draw a picture of himself. All testing was done during the beginning months of the school year.

The reading, arithmetic, Frostig, and conservation tests were scored according to standard procedures. The self-drawings were scored on the basis of the Harris-Goodenough Draw-a-Man (boys' drawings) and Draw-a-Woman (girls' drawings) scales. The drawings were scored by two independent scorers. In all cases, raw scores were used for data. Also, it was determined that Ss scoring four or better on the conservation test would be defined as being conservers, and Ss scoring three or less would be defined as being non-conservers.

## RESULTS

Of the 20 kindergarten Ss, 19 scored zero on the conservation test; one kindergarten S conserved. Seven first grade Ss conserved, and 13 second grade Ss conserved.

Because distributions were not normal, a non-parametric test, the Kolmogrov-Smirnov (K-S) test for differences was used.[2] Tests were done comparing the grade levels for differences between frequencies of conservers and non-conservers. A comparison between first and second grade Ss was not significant (K=8, df=2); a comparison between kindergarten and first grade Ss was significant (K=17, df=2, $p < .01$).

The following comparisons involved only scores of first and second grade Ss. A K-S test on differences between frequencies of Frostig scores was not significant (K=8, df=2), while a K-S test between conservers and non-conservers on the difference between frequencies of Frostig scores was significant (K-11, df=2, $p < .01$). Similarly, K-S test was done comparing first and second grade Ss for differences of scores on the self-drawings; there was no significant difference (K=3, df=2). Also, no significant difference was found with a K-S test done comparing conservers and non-conservers for differences of scores on self-drawings (K=6, df=2).

The following comparisons involved groups of unequal number, therefore results of the K-S test are presented as proportion D scores. A K-S test comparing first grade conservers and non-conservers for differences between reading scores (D=.286, df=2) and a K-S test comparing second grade conservers and non-conservers for differences between reading scores (D=.267, df=2) were not significant.[3] A K-S test comparing first grade conservers and non-conservers for differences between arithmetic scores (D=.615, df=2) and a K-S test comparing second grade conservers and non-conservers for differences between arithmetic scores (D=.549, df=2) were also not significant.

Spearman rho correlations with second grade Ss were as follows: Frostig scores and conservation scores (rho=.795, N=20, p .01); self-drawing scores and conservation scores (rho=.417, N=20, N.S.); reading scores and conservation scores (rho=-.307, N=20, N.S.); and arithmetic scores and conservation scores (rho=.566, N=20, $p < .01$).

## DISCUSSION

All of the data presented supports Piaget's theory that conservation is developmentally determinate and discrete. First, even though a 12 point continuous scale was used to measure conservation ability, Ss tended to score either zero or in the four to 12 point region; second, as can be seen by examining mean conservation score distributions divided by age and sex (see Figure 1), the scores definitely increase with age, a transition from non-conserving scores to conserving scores (as defined in the present study) takes place around six and one half to seven years of age, and mean scores approach levels that would suggest definite conservation ability around seven and one half to eight years of age. These findings are consistent with most previous studies concerning normative ages for conservation.

Piaget's ideas on perception and conservation are partially supported as can be seen by examination of frequency distributions for conservation and Frostig scores (see Figures 2 and 3). Conservation is discrete, while the distribution of Frostig scores is more continuous as Piaget would predict. However, it should be noted that there was a significant difference between the performances of conservers and non-conservers on the Frostig test as well as a strong correlation between the conceptual test and perceptual test scores. This is probably due to the fact that the tasks of visual perception used involved instructions and manipulations which require some conceptual sophistication; likewise, the conservation tasks used involve visual perception. It would be difficult to develop conservation tasks that do not involve perceptual abilities and perceptual tasks that do not involve conceptual abilities.

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[2] All statistics presented are based on two-tailed tests.

[3] First and second grade results could not be combined for reading or arithmetic because the tests used were specific for each grade level.

TABLE I
MEAN CONSERVATION SCORES IN COMPARISON WITH NORMS[4]

| | Boys | | Girls | |
|---|---|---|---|---|
| | Ss | Norms | Ss | Norms |
| 5-5½ years | M - 0<br>S.D. - 0<br>N - 2 | M - .50<br>S.D. - 1.01<br>N - 22 | M - 0<br>S.D. - 0<br>N - 7 | M - .64<br>S.D. - 1.28<br>N - 14 |
| 5½-6 years | M - 0<br>S.D. - 0<br>N - 4 | M - 3.47<br>S.D. - 4.78<br>N - 17 | M - 1.10<br>S.D. - 2.61<br>N - 7 | M - 1.57<br>S.D. - 3.39<br>N - 21 |
| 6-6½ years | M - .28<br>S.D. - .48<br>N - 7 | M - 3.05<br>S.D. - 4.87<br>N - 19 | M - 2.10<br>S.D. - 2.64<br>N - 7 | M - 3.80<br>S.D. - 4.25<br>N - 15 |
| 6½-7 years | M - 4.00<br>S.D. - 3.26<br>N - 3 | M - 5.55<br>S.D. - 4.86<br>N - 20 | M - 4.00<br>S.D. - 3.26<br>N - 3 | M - 7.15<br>S.D. - 4.38<br>N - 20 |
| 7-7½ years | M - 4.60<br>S.D. - 6.97<br>N - 7 | M - 7.90<br>S.D. - 4.39<br>N - 20 | M - 3.50<br>S.D. - 4.07<br>N - 6 | M - 7.32<br>S.D. - 4.41<br>N - 28 |
| 7½-8 years | M - 8.50<br>S.D. - .35<br>N - 4 | M - 10.38<br>S.D. - 3.46<br>N - 8 | M - 5.00<br>S.D. - 2.08<br>N - 3 | M - 10.80<br>S.D. - 1.79<br>N - 5 |

[4]Norms are from the Concept Assessment Kit-Conservation Manual (Goldschmid and Bentler, 1968).

FIGURE 1
MEAN CONSERVATION SCORES

FIGURE 2
CONSERVATION SCORE FREQUENCIES

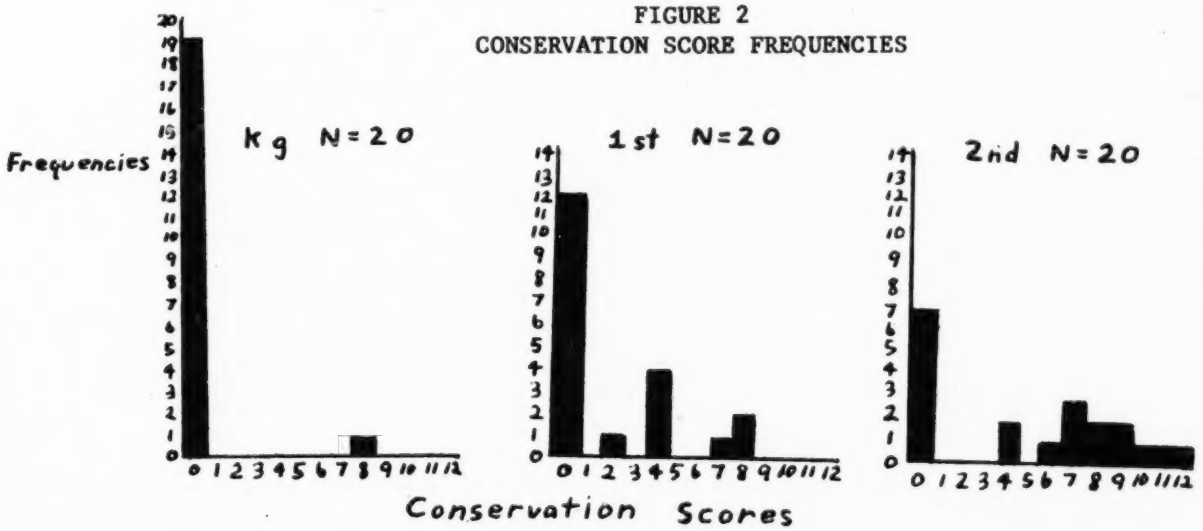



FIGURE 3
FROSTIG SCORE FREQUENCIES

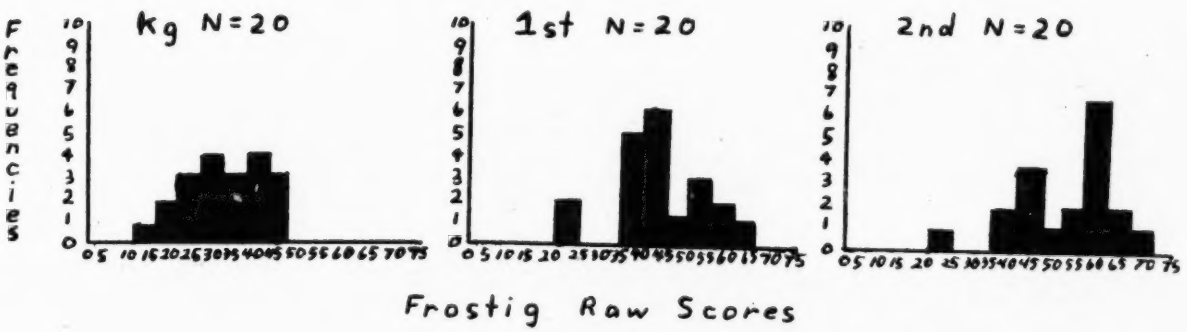



FIGURE 4
DRAW-SELF SCORE FREQUENCIES

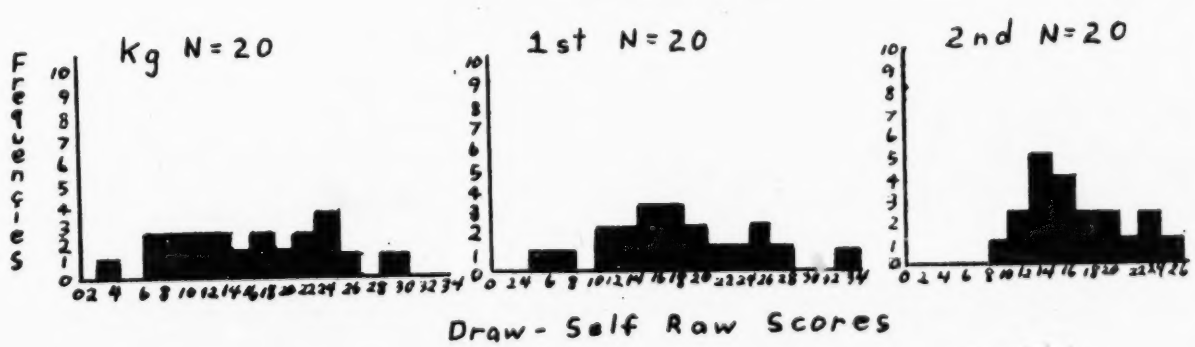


FIGURE 5
READING SCORE FREQUENCIES

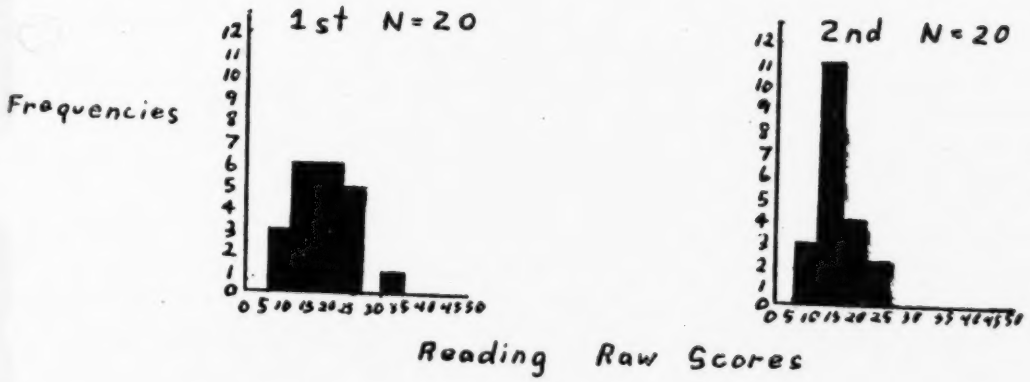
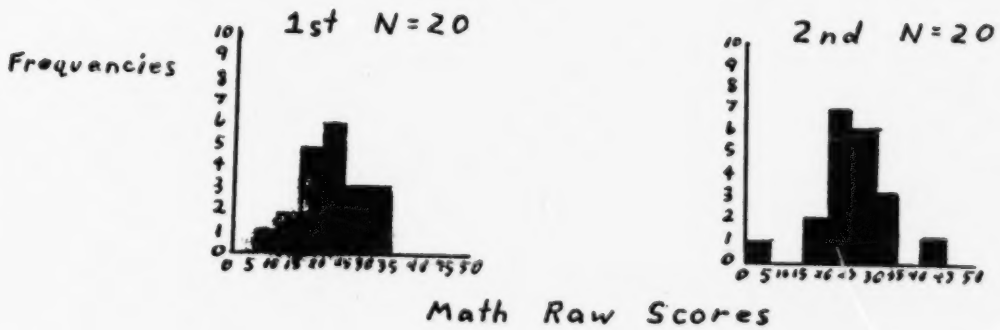



FIGURE 6
MATH SCORE FREQUENCIES



The distribution of self-drawing scores, like the distribution of the Frostig scores, is continuous (see Figure 4); however no significant differences were found between the self-drawing scores of conservers and non-conservers, and no correlation could be demonstrated for self-drawing scores and conservation scores. Piaget, in a discussion of children's drawings as a reflection of conceptualization of space (Piaget and Inhelder, 1956) states that pictures show independent development in three levels; these levels are: 1) synthetic incapacity (unrealistic view); 2) intellectual realism (as things should be); 3) visual realism (as things are actually seen). It is possible that most of the Ss in the present study were at the same level, most likely that of intellectual realism, and this could account for the results involving the self-drawings.

There were no significant differences between conservers and non-conservers for reading or arithmetic scores, and as can be seen, the frequency distributions for reading and arithmetic are continuous as opposed to the conservation distributions which are discrete and highly skewed in a positive direction (see Figures 2, 5 and 6). It is of interest that there was a significant correlation between the arithmetic scores and conservation scores, while no relationship was found for conservation and reading. These results, based on standardized tests, support similar findings, based on grades, of Goldschmid and Bentler (1968).

Finally, it should be noted that the mean conservation scores from the sample of the present study in all age-sex categories (see Table 1) were considerably lower than the norms established by Goldschmid and Bentler (1968). It is felt that this result is most likely due to the fact that the Goldschmid-Bentler norms were based on a sample that included the entire socio-economic spectrum, but which had a sampling bias toward middle-class children. The present sample consisted entirely of children from lower socio-economic backgrounds. A similar finding was cited in a study by Almy (1966) in which lower socio-economic children progressed developmentally in the same sequence, but at a slower pace than middle-class children studied.

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**Perception of Relative Velocity in Elementary School Children**

University of Southern California
School of Education, Masters Thesis, August 1971
Kiomars Fiazi

The relationship between chronological age, sex, socio-economic status and ethnic backgrounds on the perception of relative velocity (conservation of velocity) was studied. It was found that among the 247 subjects, ranging in age from 7 years to 9 years and 5 months, the conservation of velocity was significantly dependent on the chronological age. Less significance was found in the effect of socio-economic level and ethnic origin; and there was no relationship between sex of the subjects and the dependent variable.

**The Impact of Piaget on Guidance***

John C. Gowan
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The intensive, lifelong studies of the cognitive processes of normal children by Jean Piaget, one of our contemporary geniuses, become increasingly valuable to us in our attempts to understand more of child development. His work has always had implications for curriculum construction and for guidance and psychological services as well. The impact on the latter has tended to be less clearly defined than is desirable. Thus, the intent of this paper is to show the significance of Piaget's work for guidance . . .

Counselors who become familiar with Piaget's stages of cognitive development will possess a new means for understanding children. The unifying idea here is *cognitive competence*, its levels of development, and the effect of its stimulation or retardation on the personality of the child. It is true that intuitive counselors have been using these for a long time, but lack of a model has prevented them from knowing why what they were doing was right and, more importantly, from being able to communicate their ideas constructively and easily to others. The intuitive counselor is like the man who could find the cat in the dark room, and Piaget is like the man who turned on the light so that we all can see where the cat is. Now that the light is on, a great deal of reorganization becomes possible and easy. For example, we now see the importance of enabling counselors to think in terms of a more cognitive approach to mental health, some hypotheses of which are as follows:

1. At certain critical stages in the child's development, it is cognitive competence, rather than emotional development, that is central.

2. Cognitive competence is the child's chief mainstay to reality and hence the chief bulwark of his general emotional stability. Conversely, cognitive incompetence is the chief precursor of emotional instability.

3. Cognitive development on schedule is conducive to emotional health and a proper self-concept, and lack of cognitive development on schedule is conducive to emotional disturbance and lack of a proper self-concept.

4. Cognitive development may be stimulated by proper and appropriate curriculum experiences directed toward the student's particular abilities and stage of concept development.

5. Cognitive competence can be enhanced by proper and appropriate guidance experiences that emphasize the development of realistic and optimistic self-concepts.

6. Guidance efforts to promote cognitive competence involve: (a) sympathetic and supportive individual attention, (b) promotion by counselor of student's ability to make changes in his self-concept through changes in his relationships, and (c) remedial retraining in basic skills . . .

Part of the counselor's role entails his sharing his understanding of the child's cognitive development with teachers. Blocking of a child's cognitive needs, like repression of the child's creative needs, may lead to personality problems.

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**Orientation to the University Affiliated Training Program**
**Children's Hospital of Los Angeles**

This University Affiliated Program is one of 30 similar programs throughout the United States. The UAP at Children's Hospital of Los Angeles is funded by grant (MCH Project #914) from Maternal and Child Health Services, and Developmental Disabilities, Department of Health, Education and Welfare, and a special project training grant from the U.S. Office of Education, Bureau for the Education of the Handicapped. It is located on the campus of Children's Hospital, with Administrative Offices located four blocks south of the main hopsital at 4585 Lexington Avenue. Dr. Wylda Hammond is the Director. Training and clinical practice is provided both in the Hospital and in its Rehabilitation Center as well as in the Community.

Our prime affiliation is with the University of Southern California. Affiliations include the University of California at Los Angeles, California State University, Loma Linda University, Veterans Administration Hospital, Stanford University, University of California at Santa Barbara, and others.

The philosophic base of both our service and training programs is that multi-handicapping conditions are of such psycho-social-biological complexity that the knowledge and skills of many disciplines are required in order to implement a resolution. We presume that quality and creative service are essential to the training base.

**Training Goals**:

(1) To train professionals to work with the multi-handicapped, their families, and with the community in its broadest sense;

(2) To increase knowledge of professionals for each other, including what they do or don't do and can and can't do;

(3) To aid trainees in one discipline to develop skills applicable to their functioning from other disciplines, through team functioning;

(4) To train professionals to effectively collaborate with each other in an interdisciplinary process;

(5) To train professional leaders who can stimulate and develop interdisciplinary programs of service, education and training.

Families and extended families are involved. Ethnic groups include Caucasian, Black, Mexican-American, Oriental, etc. Economically, our families range from those receiving public assistance through those with incomes of $15,000 per year or more. Most major religions are represented. Problem areas include those with organic and non-organic etiologies as well as combinations of these. We stress social adjustment and social functioning related to multi-handicapping conditions.

The following fields are represented on the staff and/or in the student population at the University Affiliated Program: administration, clinical psychology, communicative disorders, dentistry, education, nursing, nutrition, occupational therapy, pediatrics, physical therapy, psychiatry, school psychology, social work, and special education.

## UAP Faculty and Staff

## 1972-1973

Wylda Hammond, M.D., Director, UAP and Director for Training in Pediatrics, Associate Professor of Pediatrics, USC School of Medicine.

Gerald Lubin, M.D., Assistant Director UAP and Director for Training in Psychiatry, Assistant Professor of Psychiatry and Pediatrics, USC School of Medicine.

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Christine Harris, Ph.D., Director for Training in Communicative Disorders, Adjunct Assistant Professor in Communicative Disorders, USC.

James Magary, Ph.D., Director for Training in Education, Associate Professor of Educational Psychology and Special Education, USC School of Education.

Marie Poulsen, Ph.D., Assistant Director for Training in Education.

Mary Lou de Leon, R.N., M.N., Director for Training in Nursing. Clinical Faculty, UCLA.

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Nancy Takata, O.T.R., Director for Training in Occupational Therapy, Clinical Assistant Professor of Occupational Therapy, USC, Department of Occupational Therapy.

Janith Hurff, O.T.R., Senior Occupational Therapist.

Lorraine Ogg, R.P.T., Director for Training in Physical Therapy, Clinical Associate Professor in the Physical Therapy Department, USC., Clinical Instructor in Physical Therapy, Stanford University.

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Herbert Rock, M.S.W., Social Work, USC Field Instructor.

Arlene Hill, M.S.W., Social Work, UCLA Field Instructor.